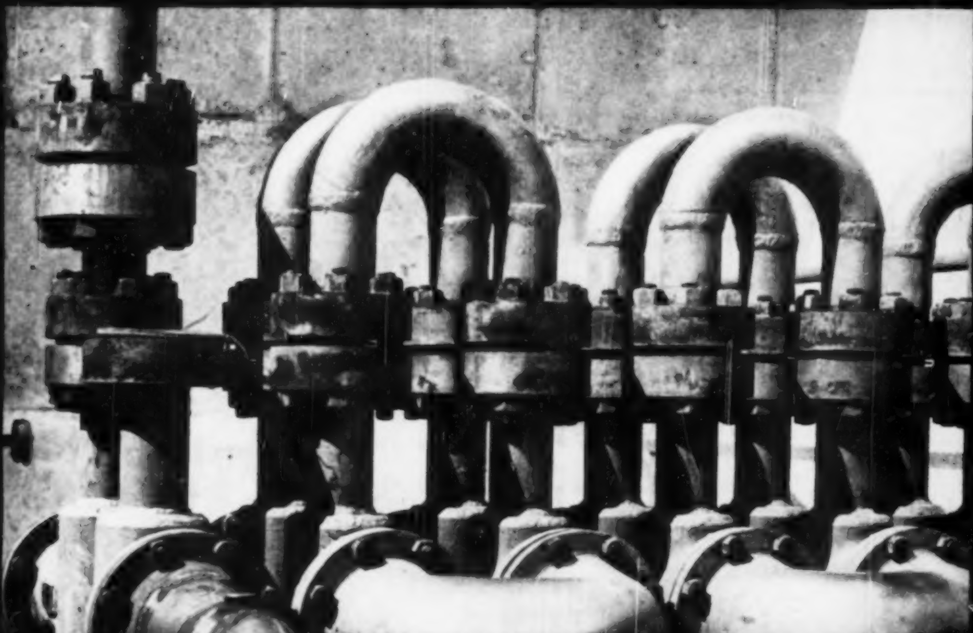
AUGUST 1949

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING



ENGINEERING HIGH-PRESSURE EQUIPMENT, LIKE THIS HEAT EXCHANGER, IS THIS MONTH'S REPORT SUBJECT. P. 107

A McGraw-Hill Publication

Fifty Cents

Precision through Care in Tube-Turn welding fittings

"Mike" checks 'em all!

THE wall thickness of Tube-Turn welding fittings simply has to be right. Every single Tube-Turn welding fitting is micrometer-checked before being put on the market.

Instruments of exclusive design do the trick. They measure wall thickness at the center of an elbow or 180° return as easily, accurately as at any other point. Whether it's ten, a hundred, or a thousand, the Tube-Turn welding fittings you buy are properly matched to pipe of corresponding size —at the face and throughout the fitting. Cut a Tube-Turn welding elbow to any odd angle required. It still lines up.

This micrometer check for dimensional accuracy is a small part of the thorough scrutiny to which the finished Tube-Turn product is subjected.

More than thirty skilled inspectors check for true circularity, accurate center-to-face dimensions, uniformity of curvatures, soundness of outside and inside surfaces, wall thickness of butt ends, bevels, lands, and quality of machining.

And that's just a fraction of the total *care* involved in the manufacture of Tube-Turn welding fittings.

Perfection begins with the raw material which is checked for conformity to required chemical composition and physical properties. It must pass all pre-determined requirements before acceptance for production of Tube-Turn welding fittings. Special materials, of course, undergo special tests.

When you buy "Tube-Turn" you want good connections. That's what you get, every time.

TUBE TURNS, INC.

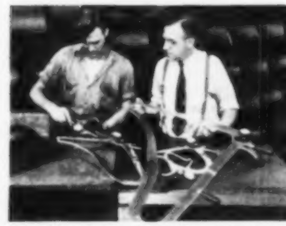
238 East Broadway, Dept. H, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

TUBE-TURN

tt

WELDING FITTINGS AND FLANGES



Five different-size gauges of exclusive design are used to check the wall thickness of every Tube-Turn welding fitting.

While one inspector checks the diameter of a 90° elbow, the other checks on perfection of inner wall.

Inspectors check the center-to-face dimension of a 20"-90° Tube-Turn welding elbow.

A part of the final inspection department. Here, Tube-Turn welding fittings undergo intensive instrumental and visual inspection.

AUGUST
1949

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THIS MONTH

EVERY MONTH

An index to advertisers will be found on the fifth page preceding the back cover

Published monthly. Price 50 cents per copy. Address communications about subscriptions to J. E. Blackburn, Jr., Director of Circulation, Chemical Engineering, with Chemical & Metallurgical Engineering. Subscription rates—United States and possessions: $3 per year, $4 for two years, $5 for three years; Canada: $4 per year, $6 for two years, $8 for three years (payable in Canadian funds); Pan American countries: $10 for one year, $16 for two years, $20 for three years; all other countries: $15 for one year, $30 for three years.

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Entered as second-class matter Sept. 3, 1936, at Post Office at Albany, N. Y., under act of March 3, 1879. Return Postage Guaranteed.

Publication Office: 99-129 North Broadway, Albany 1, N. Y. Editorial and Executive Offices: 330 West 42nd Street, New York 18, N. Y. Cable Address: McGraw-Hill, New York. James H. McGraw (1860-1948), Founder. James H. McGraw, Jr., President; Curtis W. McGraw, Vice President and Treasurer; Eugene Duffield, Senior Vice President, Publications Division; Nelson Bond, Vice President and Director of Advertising; Joseph A. Gerardi, Secretary; J. E. Blackburn, Jr., Vice President and Director of Circulation. Branch Offices: 520 North Michigan Ave., Chicago 11; 68 Post St., San Francisco 4; Aldwych House, Aldwych, London W. C. 2; Washington 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Los Angeles 14; Atlanta 3; Pittsburgh 22; Houston 2.
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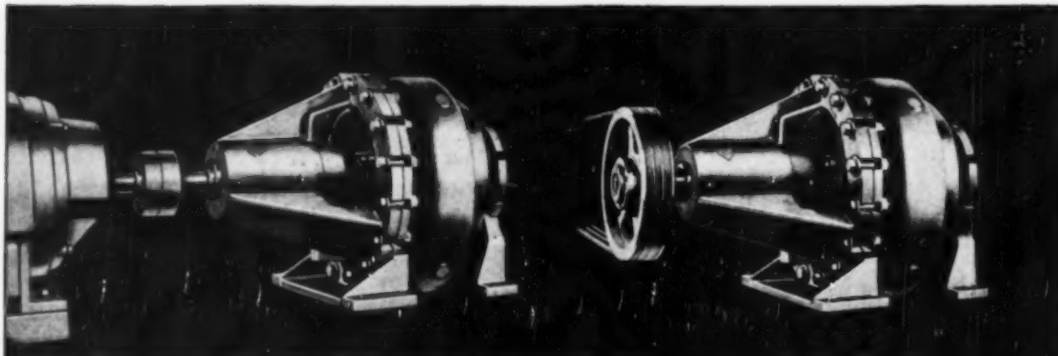
Solve Fluid Flow

WITH THESE ALLIS-



These Solids Pumps Look Alike, but...

THE "PW" IS FOR *CORROSIVE* FLUIDS

Working parts of direct-driven PW solids pump are made of special alloys designed for maximum resistance to *corrosion*. These Allis-Chalmers pumps handle a wide range of chemical pulps and liquors with negligible dilution from sealing water.

- **Has special corrosion-resistant alloy parts.**
- **Designed for direct-drive, motor or engine.**
- **Handles up to 40% solids in suspension.**
- **Only 5 major parts — high accessibility.**
- **175 to 8,000 gpm; heads to 140 ft.**

Send for Bulletin 08B7112.

THE "CW" IS FOR *ABRASIVE* FLUIDS

Working parts of CW solids pump are made of *Allisite* alloy, an extremely hard, non-machinable alloy that offers remarkable resistance to *abrasion*. Effective in handling slurries, tailings, sludges. Delivers near-rated capacity until parts are completely worn out.

- **Has hard *Allisite* alloy working parts.**
- **Driven through *Texrope* V-belt drive and motor.**
- **Also handles up to 40% solids.**
- **Parts accessible without disturbing piping.**
- **175 to 8,000 gpm; heads to 140 ft.**

Send for Bulletin 08B6381B.

PROFITABLE SOLUTIONS to your fluid handling problems depend on getting the *right* pumps specified for your job in the first place. Then your pumps will deliver rated capacity month after month . . . and you'll have better control of your fluid flow operations.

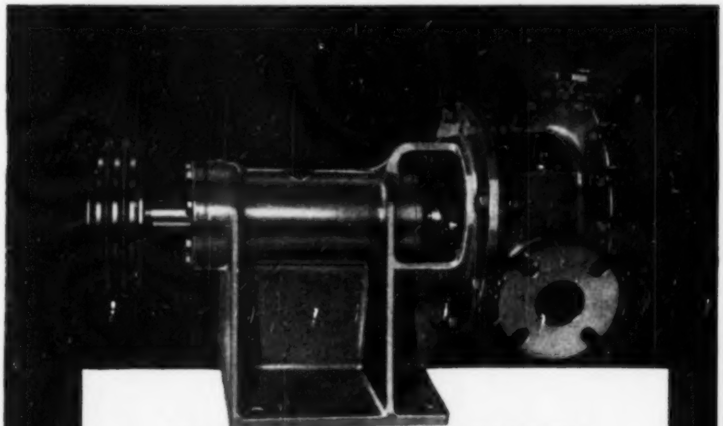
Insist on getting top value in terms of durability when buying pumps. The centrifugal pumps shown here are excellent examples of sound pump design . . . with strength features that "pay off" in long, reliable service.

Another important thing — get pumps that are easy to install and maintain. Here too, you'll find Allis-Chalmers offers pumps designed for ease of packing . . . ease of disassembly . . . ease of replacing standard parts.

Find out more about this modern pump line from the A-C representative in your area.

Problems

CHALMERS PUMPS



PROCESS PUMP FOR ABRASIVES, CORROSIVES, ACIDS OR ALKALIS

This Allis-Chalmers process pump is winning acceptance for a wide variety of chemical processing applications. Operators report big savings in replacement parts costs! Obtainable with a variety of special alloy working parts, it can be used for corrosive, abrasive, acidulous or alkaline liquors.

- **Available with choice of alloy parts.**
- **Stuffing box is on suction side of pump; pressure on packing can't exceed suction head.**
- **Rotating element can be adjusted axially to maintain pumping capacity and head.**
- **15 to 1,300 gpm; heads to 275 ft.**

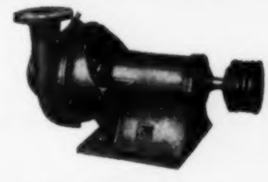
Send for **Bulletin 08B6615A.**

A-2723

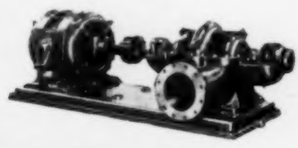
Texrope, Pedrifugal, Allisite are Allis-Chalmers trademarks.

ALLIS-CHALMERS, 1147A SO. 70 ST.
MILWAUKEE, WIS.

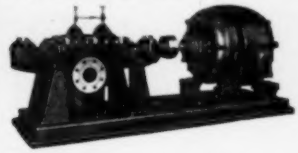
OTHER ALLIS-CHALMERS CENTRIFUGAL PUMPS FOR THE CHEMICAL INDUSTRY



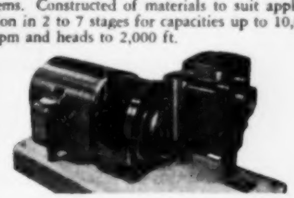
SINGLE SUCTION base mounted and close-coupled type pumps. Either type available of special alloy construction for corrosive liquids. **Bulletins 52B6351A and 52B6140A.**



SINGLE STAGE double suction, split casing pumps. Can be constructed of many special machinable alloys. 30 to 170,000 gpm; heads to 475 ft. **Bulletin 08B6146.**



MULTI-STAGE pumps for high pressure systems. Constructed of materials to suit application in 2 to 7 stages for capacities up to 10,000 gpm and heads to 2,000 ft.



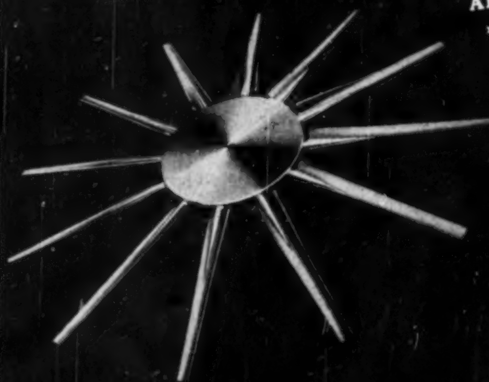
SELF-PRIMING pump has rapid, automatic priming action. Full capacity after 3 minutes operation on a 20 ft suction line. Sizes to 350 gpm; heads to 300 ft. **Bulletin 08B6319B.**

PEDRIFUGAL Economy pump for average requirements up to 500 gpm; 100 ft heads.

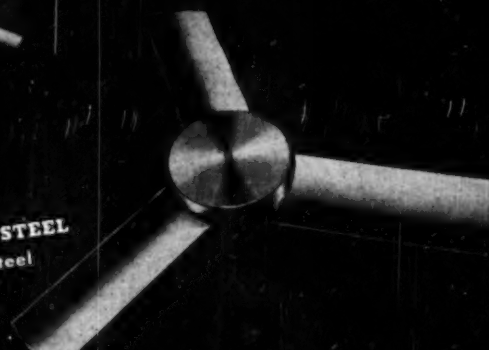
ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

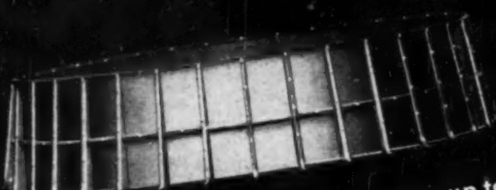
NEW Marley FANS
For Cooling Towers and DriCooler*
Do The Job Better . . . Longer



ALUMINUM
- Multibladed
- Balanced
- Unusually quiet and smooth operation
- High tensile cast aluminum alloy
- Adjustable pitch
- Air foil section
- Twisted and tapered blades



STAINLESS STEEL
- All stainless steel
- Adjustable pitch
- Balanced
- Air foil section
- Quiet and smooth operation



FAN CYLINDER
- Unusually rugged
- All bolted
- Flared throat
- Non-corrosive

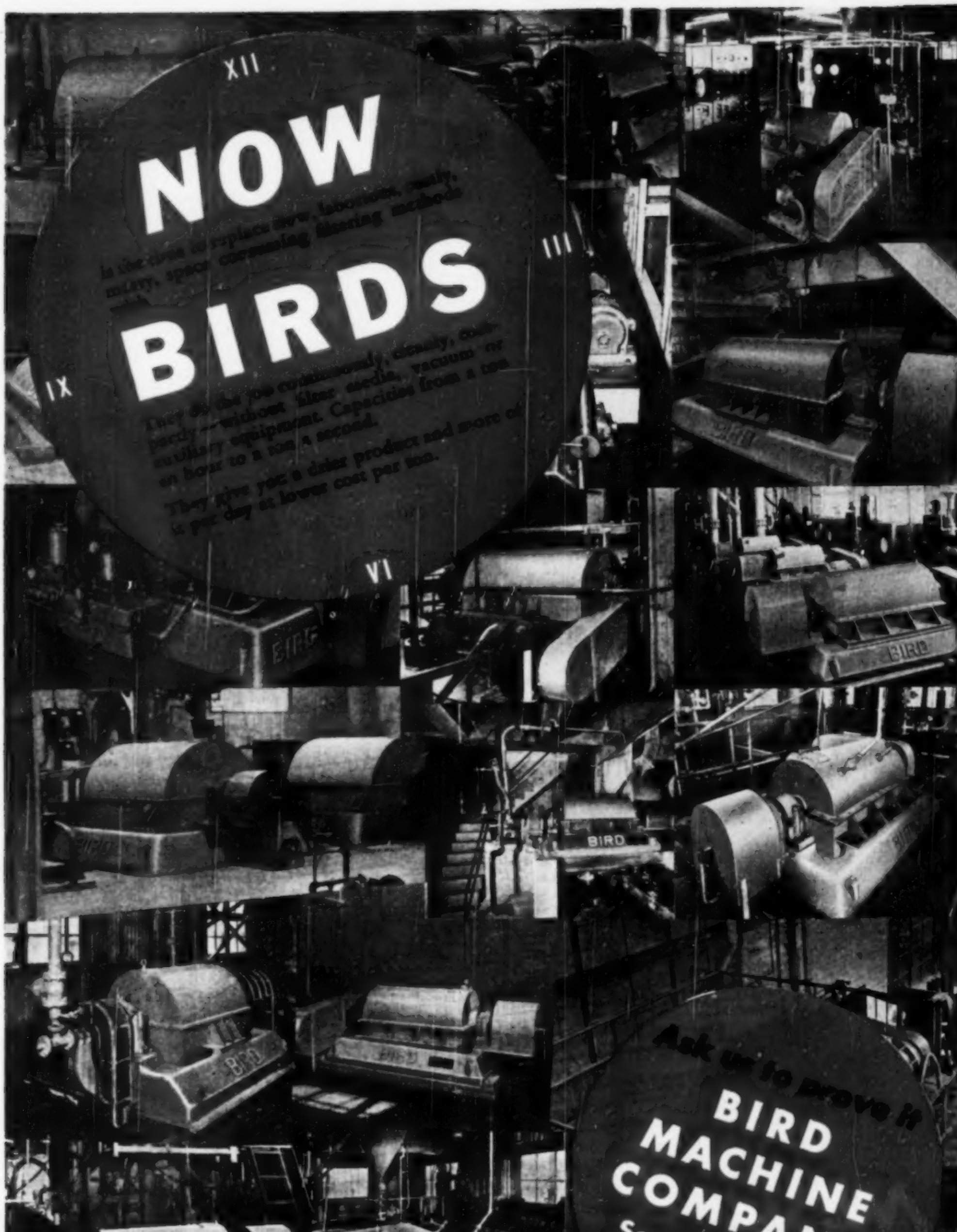
Marley Fans and Fan Cylinders team up to do the job better . . . longer! These fans are designed and manufactured by The Marley Company especially and exclusively for water cooling applications.

Your new MARLEY Water Cooling Tower or "DriCooler"* will have this equipment, but you can improve your present water cooling tower, right now, regardless of size or make with these new MARLEY FANS.

*DriCooler is the exclusive trade-mark of The Marley Company, Inc., and designates its finned tube dry surface cooling equipment.

MARLEY

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS


XII
NOW
III
BIRDS
IX
They do the job continuously, cleanly, completely — without filter media, vacuum or auxiliary equipment. Capacities from a ton an hour to a ton a second.
They give you a drier product and more of it per day at lower cost per ton.
VI
Ask us to prove it
BIRD MACHINE COMPANY
South Walpole
Massachusetts

Increase Yarn Production

Operating on short centers without slip they drive spinning mules at rated speed

Above are seen two of the five Link-Belt Silent Chain drives recently installed at Roxbury Carpet Company's mill at Saxonville, Mass. These drives operate 320 spindle spinning mules, through line shafts and replace another type of drive which, because of the short centers, permitted a waste of power and speed through unavoidable slip. By maintaining full rated speed, the Link-Belt Silent Chain drives assure that the spinning mules will operate at their rated capacity. Link-Belt Silent Chain drives operate efficiently on short centers, run slack thus avoiding high bearing pressures and require no attention other than occasional lubrication.

LINK-BELT COMPANY 11,502

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 3, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities.

LINK-BELT

Power Transmission Machinery
"THE COMPLETE LINE"

LINK-BELT Industrial Standard Silent Chain Drives

offer four new features combined with the well-known advantages of silent chain:

1. Interchangeability: They will operate on sprockets cut to the new Industrial Standard tooth form; likewise Link-Belt standard silent chain sprockets will fit the new Industrial Standard silent chain.

2. Taper-Lock Bushings: Made of gray iron with high steel content. Easy assembly and tight fit. No reboring necessary. Easy removal too!

3. All Steel Pinions, Hardened Teeth: Finished bores and key-ways for standard NEMA motor shaft sizes.

4. Easy Selection: The "Pre-selected" drives listed in Book 2125-A can be delivered from stock immediately by your nearest Distributor or Factory Branch Store. For easy-to-use selection tables, on ½ to 50 h.p. stock drives, ask for Book 2125-A.

A Gaylord Sales Office is near you!

GAYLORD CONTAINER CORPORATION

General Offices: Saint Louis

Corrugated and Solid Fibre Boxes • Folding Cartons • Kraft Grocery Bags and Sacks • Kraft Paper and Specialties

For 17 years General Electric has used Tri-Sure Closures

in shipping

- ✓ RESINS
- ✓ VARNISH
- ✓ SHELLAC
- ✓ FORMEX ENAMEL
- ✓ GLYPTAL SOLUTION
- ✓ HEAVY PAINT

Resins, varnishes, shellacs and other liquids play an important part in the manufacture of many General Electric products. The quality of these liquids must be high. And to make sure that shipments can be made with security from tampering Tri-Sure Closures* are used.

Many firms in the first rank of American industry have used Tri-Sure protection since the inception of the Tri-Sure Closure in 1932. And during those 17 years, hundreds of shipments of G-E chemicals have attested the efficiency of the Tri-Sure *flange*, *plug* and *seal*.

Leading manufacturers of products shipped in drums will not accept a substitute for Tri-Sure Closures*—because their experience has proved that there is no substitute for *100% security* from leakage, seepage, tampering and contamination. You can give *your* shipments that kind of security—and give *your* product complete protection—by always specifying "Tri-Sure Closures" when you order drums.

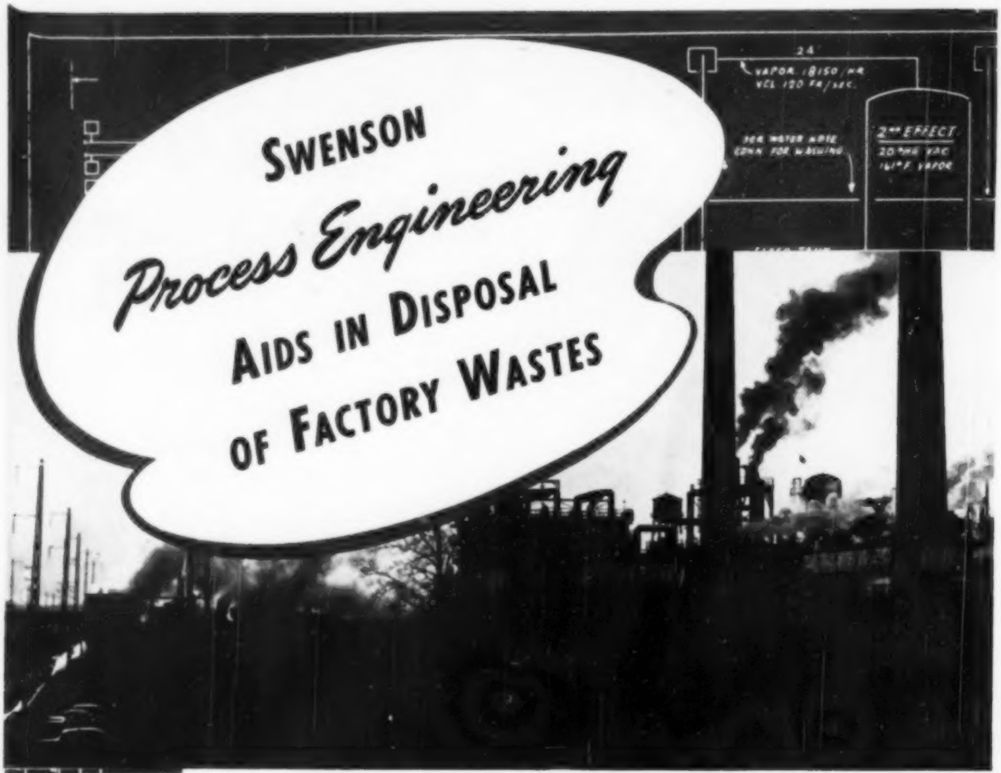
* The "Tri-Sure" Trademark is a mark of reliability backed by 27 years serving industry. It tells your customers that genuine Tri-Sure flanges (inserted with genuine Tri-Sure dies), plugs and seals have been used.

Play Safe by Specifying Tri-Sure On Every Drum Order

Reg. U. S. Pat. Off.

CLOSURES

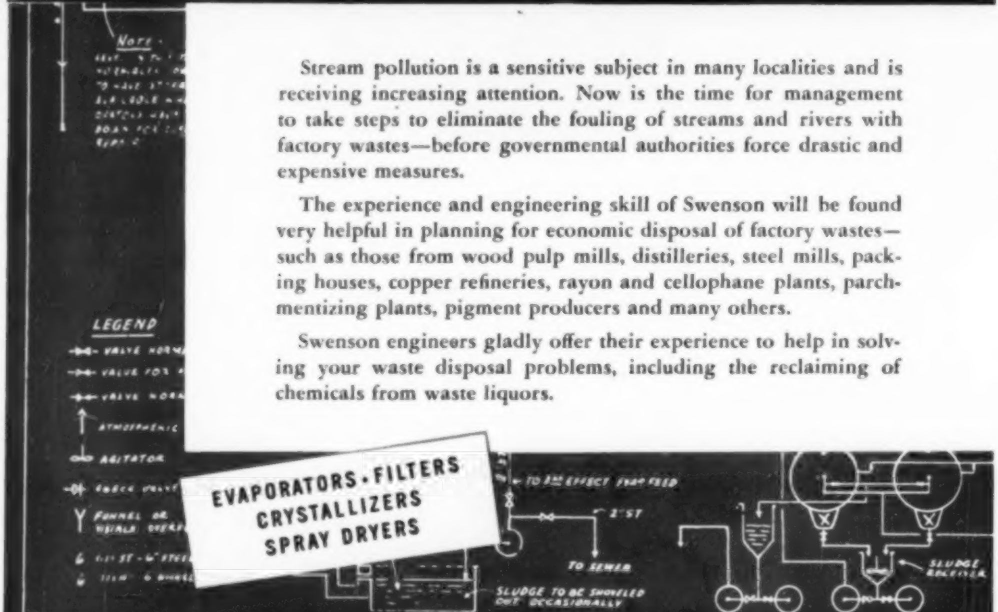
AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA



Stream pollution is a sensitive subject in many localities and is receiving increasing attention. Now is the time for management to take steps to eliminate the fouling of streams and rivers with factory wastes—before governmental authorities force drastic and expensive measures.

The experience and engineering skill of Swenson will be found very helpful in planning for economic disposal of factory wastes—such as those from wood pulp mills, distilleries, steel mills, packing houses, copper refineries, rayon and cellophane plants, parchmentizing plants, pigment producers and many others.

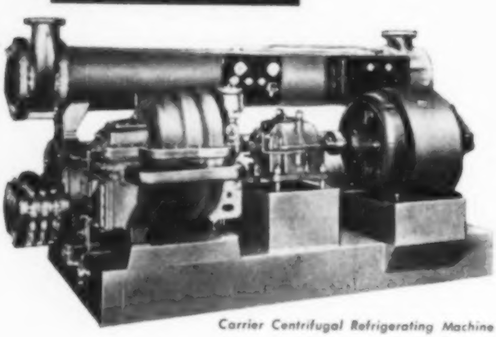
Swenson engineers gladly offer their experience to help in solving your waste disposal problems, including the reclaiming of chemicals from waste liquors.



PROBLEM:

How to do your refrigeration job better

SOLUTION:



Carrier Centrifugal Refrigerating Machine

Do what hundreds of others have done — choose a Carrier Centrifugal Refrigerating Machine. In application after application it has proved itself more economical and more efficient than other equipment. Here are some factors which recommend its use:

1 ***Wide range of capacities:*** Carrier Centrifugals are available in a complete range of sizes, from the smallest of 100 hp. to the largest of 2000 hp.

2 ***Wide range of temperatures:*** Requirements from +60° to −150° F. are economically, efficiently attained.

3 ***Wide range of refrigerants:*** To date, fourteen different refrigerants have been successfully used in Carrier Centrifugals. Whether desirability or availability governs your situation, they give you a wide choice of refrigerants.

4 ***Fine control:*** Centrifugals are inherently constant-temperature machines, consequently ideal for processes requiring fine control of temperatures.

5 ***Efficient drivers:*** They give heat balance, and meet other job conditions as well, using all kinds of motors and turbines.

6 ***Low maintenance and operating costs:*** Few wearing parts, absence of erosion and simplicity in design keep costs lower than for any other type of refrigeration machine of comparable capacity.

7 ***Solvent recovery:*** Efficient solvent recovery requires unusually low temperatures and large capacity from a plant. Carrier Centrifugals provide the dependable, low-cost answer.

8 ***Chlorine condensing:*** This eliminates extra heat exchangers. Carrene No. 2*, the refrigerant, on one side of tube wall and chlorine on the other side have no affinity for each other, as with ammonia.

9 ***Installation advantages:*** Due to their relatively light weight and absence of operating vibrations, Carrier Centrifugals can be mounted on upper floors in most cases.

Pioneer and leader in the field, Carrier has the know-how that assures you of outstanding performance in its equipment. Get the full facts about Carrier Centrifugal Refrigerating Machines from your nearest Carrier representative, or write Carrier Corporation, Syracuse, New York.

*Reg. U. S. Pat. Off.

Carrier

CENTRIFUGAL COMPRESSORS • REFRIGERATION EQUIPMENT

To help you enjoy a *carefree* vacation *nothing equals Stainless Steel!*

WE don't mean to imply that stainless steel equipment *alone* will guarantee trouble-proof plant operation while you are away — but it certainly helps.

With Stainless Steel to safeguard your product from contamination—to prevent off-quality runs—to withstand careless handling and severe use—you can be reasonably certain that as far as your equipment is concerned you have little to worry about.

The peace of mind that the use of Stainless insures is an intangible benefit often overlooked and hard to measure in dollars and cents. But, in importance, it ranks alongside other well-recognized advantages that Stainless Steel offers. Superior corrosion resistance. Freedom from rust and tarnish. High resistance to heat. Low cleaning costs. Longer service life.

. . .

These superior qualities of Stainless Steel that pay off in bigger production, fewer shut-downs, and in a better, more uniform product also pay *extra* dividends in making vacations a lot more pleasant by quieting that small inner voice that keeps saying, "Wonder how they're getting along without me at the plant?"

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO · CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH & CHICAGO
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U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

9-1808

UNITED STATES STEEL

voltage distribution

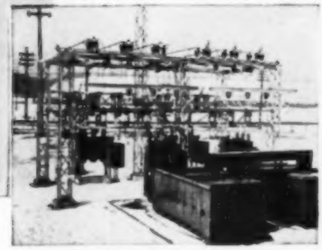
to reduce power losses, cut equipment costs

You see it in more and more chemical plants today. It's the trend to load-center power distribution. High-voltage power is distributed within the plant right to the heart of electrical load areas. There it's stepped down to utilization levels in load-center unit substations and carried to points of use by *short* low-voltage secondary feeders.

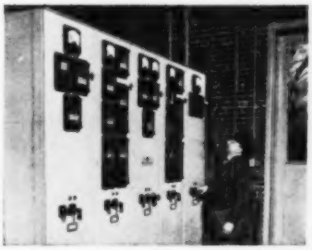
This modern method provides several advantages. By replacing long, low-voltage feeders with short ones, voltage fluctuation is kept within narrow limits, and voltage drop is lessened. This cuts power losses, permits plant equipment to run at full efficiency.

Economies in the cost of cable runs, as well as in the cost of transformers and secondary switchgear, go hand in hand with high-voltage distribution. Plant re-arrangements or additions can be made at less cost because of the flexibility of this system. Lower maintenance costs and easier installation are added advantages.

THREE KINDS OF HELP . . . NO OBLIGATION! It's a simple matter for you to get the whole story on how modern chemical plant power distribution can affect your plant layout, operating continuity, costs. As a service to industry, General Electric offers a 3-point program comprising (1) A fact-filled manual, without sales talk, on plant power distribution; (2) A slidefilm with sound that shows in detail what load-center distribution is and what it does; (3) Illustrated booklets highlighting the main points of manual and film. Write today to have this helpful program made available to you and your staff—without charge or obligation. *Apparatus Dept., General Electric Company, Schenectady, 5, N. Y.*



These completely metal-enclosed G-E package substations are factory-built to fully co-ordinated designs. You save both engineering time and installation time.



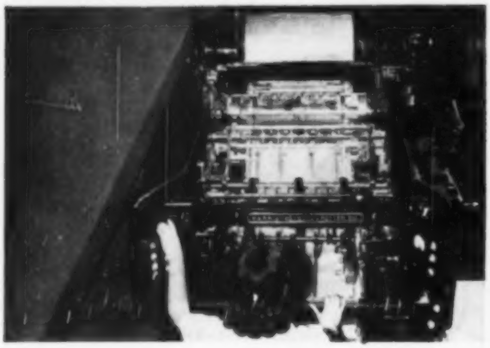
In G-E metal-clad switchgear, convenient vertical-lift construction of magne-blast air circuit breakers makes it a quick, easy job to remove them for inspection or maintenance.

Load-center unit substations—compact, fully enclosed, and built from matched components—are complete, easy-to-specify units. Made in flexible combinations, they're easy to move and rearrange.

GENERAL ELECTRIC

032-81

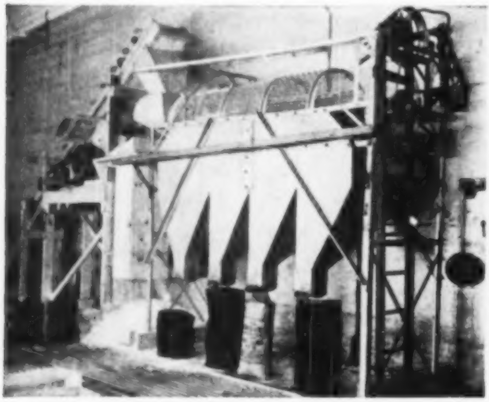
Life ...on the



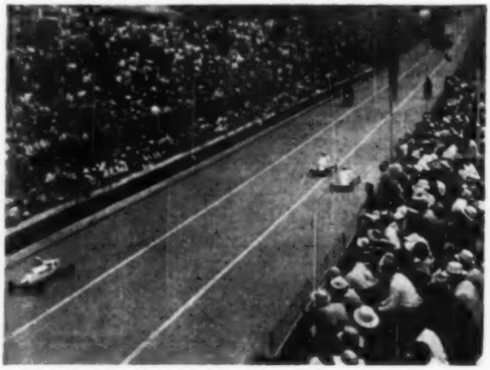
THREE QUARTERS OF A MILLION POUNDS of dry dextrin is used annually in the adhesive for U. S. postage stamps. A warm concentrated water solution of the adhesive is applied to the back of freshly printed postage stamps and dried in a single operation, following which they are fed into a perforating machine, shown above. Adhesives for labels, gummed tapes, envelopes also require remoistening properties, yet must have low hygroscopic characteristics so they will not pick up moisture and cause undesirable sticking. Cyanamid's dicyandiamide offers the adhesive manufacturer many superior properties as a fluidifying, stabilizing and rewetting agent for starch adhesives. A technical bulletin on the use of dicyandiamide in starch products is available on request.

PROTECTION OF PRODUCTS against damage and losses through insect infestation is an important subject of chemical research. In this field, Cyanamid offers a full line of fumigants for control of insects in food processing and storage plants. Included are AERO* Liquid HCN, Fumigant, CARBACRYL* Fumigant and CYANOGAS® G-Fumigant. Photo shows automatic application of CYANOGAS G-Fumigant to stream of grain on its way to elevator bins. It is estimated that this low-cost method controls insects in grain at less than ¼¢ per bushel. If you are seeking efficient methods of insect pest control, get in touch with Cyanamid's Insecticide Department for recommendations and suggestions based on wide experience in this field.

*Trade mark

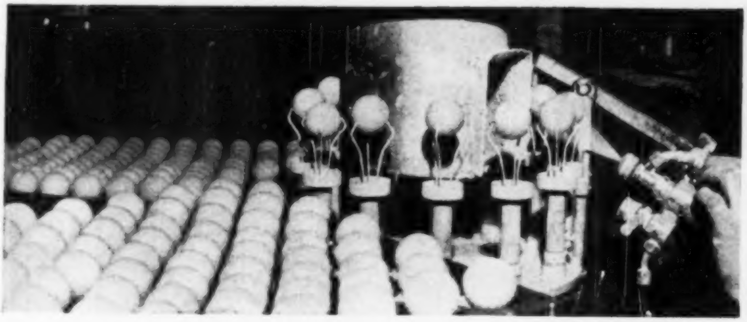


ICE IS BIG BUSINESS. In spite of the increasing use of automatic refrigeration in the home, approximately 52,000,000 tons of manufactured ice is sold each year in this country. And big news for the commercial ice and refrigeration industries has been the remarkable cost savings made possible through use of FILT-R-STIL® Water Demineralizers. In most cases, use of demineralized water has eliminated core pulling completely, cut freezing time, and lowered brine temperatures. This application of Cyanamid's Ion Exchange Resin process for producing large quantities of mineral-free water for commercial and industrial use is another interesting example of its practical value in cutting costs and improving the end product.

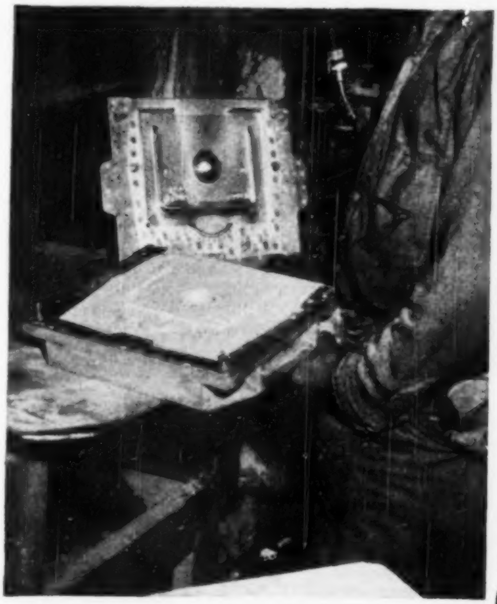


NO GAS OR OIL PROBLEMS confront the contestants in the 12th annual Soap Box Derby held this August where the youngsters will "drive" home-made replicas of modern racing cars on the long down-hill run at Derby Downs, Akron, Ohio. Nor does the modern motorist have to worry about engine lubrication as long as he is properly supplied with the new additive motor oils. A major supplier of chemical additives to the petroleum industry, Cyanamid's Petroleum Chemicals Department has announced AEROLUBE® 70, a new all-chemical oxidation and corrosion inhibitor type additive. Undiluted with the usual carrier oil, AEROLUBE 70 is a concentrated product offering many advantages in the compounding of motor oils and various industrial lubricants. For complete data, send for booklet on AEROLUBE 70 All-Chemical Additive. The coupon is for your convenience.

Chemical Newsfront



GOLF BALLS are given a coat of paint in a special machine shown that insures even application to all surfaces. And golf balls owe their brilliant white to the most universally used of all white pigments . . . Titanium Dioxide. To manufacturers of inks, papers and a host of other products, as well as paints, lacquers and enamels, Cyanamid, through its Calco Chemical Division, supplies UNITANE® (Titanium Dioxide) in both the Rutile and Anatase types. If you use Titanium Dioxide in either type, you will find helpful technical data available for the asking. Just return the coupon.



33 TO 50% FASTER BAKING TIME FOR FOUNDRY CORES is reported when Cyanamid CYCON® 151 Dry Resin Binder is used. In addition, baking temperatures of only 350° F. are required—permitting important savings in fuel. Cycon 151 is a new synthetic resin product which may be modified or extended to meet individual foundry practice requirements. It has good collapsibility, eliminates expensive cleanouts and its use produces clean, uniform castings. Use the convenient coupon to secure further particulars on this new Cyanamid product.

MAIL COUPON TODAY

American Cyanamid Company
Industrial Chemicals Division
30 Rockefeller Plaza, New York 20, N. Y.

Please send the technical literature on the products checked:

- ☐ Dicyandiamide in Starch Products
- ☐ FILT-R-STIL Water Demineralizers
- ☐ UNITANE Titanium Dioxides for

....
(type of use)

- ☐ AEROLUBE 70 All-Chemical Additive
- ☐ CYCON 151 Dry Resin Core Binder

Name.................................

Company.................................

Address.................................

C.E. 8-49

AMERICAN *Cyanamid* COMPANY

30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

FOR YEARS THE HALLMARK OF ACID RESISTING EQUIPMENT
RESISTO
LEAD VALVES
Hard Lead, Lead Lined, Iron, or Steel Body
RESISTO ACID RESISTING VALVES are recognized by the Chemical and Process Industries as embodying original, advantageous features, and assuring superior performance to successfully meet the severe conditions imposed by searching and corrosive liquids.
RESISTO VALVES are made with solid chemical hard lead alloy bodies, or with bodies lined with lead; correctly designed and perfectly machined . . . simple, durable, and strong . . . will not clog or leak . . . maximum service guaranteed.
RESISTO EQUIPMENT allows hungry acids to perform only the duties for which they were originally designed.
FREE FLOW "Y" Type
ANGLE Type
WEDGE GATE Type
DIAPHRAGM VALVE Globe Type
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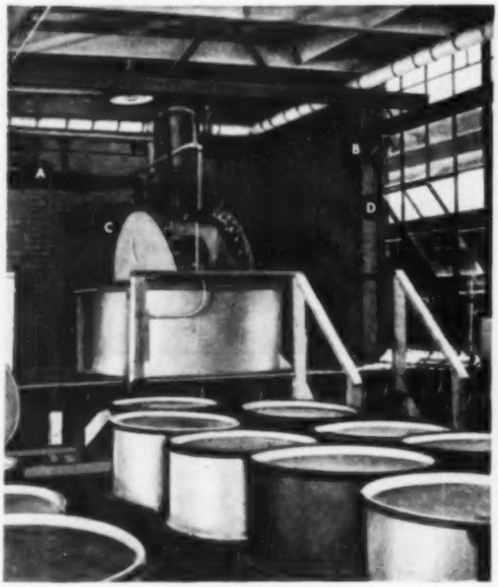
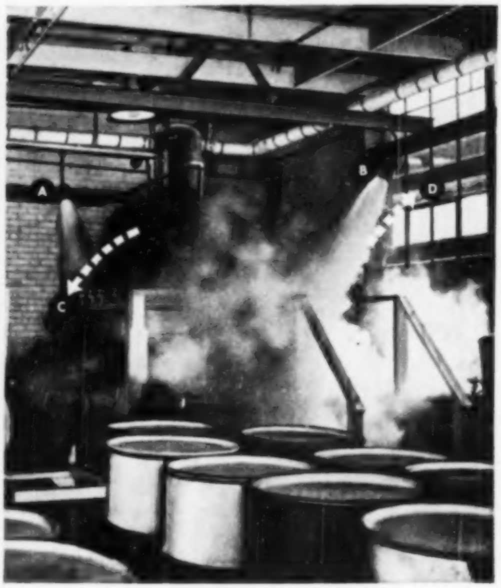
CHECK VALVE
Hard Lead Castings, Fittings, Lead Cocks
The above castings are available with flanged ends for assembly with bolts and nuts . . . also plain ends for installation by a lead burner.
Hard lead Rayon cocks, designed especially for the Rayon Industry.
RESISTO
Resisto Pipe & Valve Co.
NEW YORK, N. Y.
ELIZABETH, N. J.
A Division of
O. G. KELLEY & CO.

Watch how this Kidde system
—puts fire in its place!



Kidde Multijet Nozzles (A and B) stand ready to flood the room with flame-smothering carbon dioxide (CO_2) if a fire should break out. Hatches (C) on mixing tank and window (D) are held open by latches connected to *Kidde* pressure trips.



Here the system goes into action in a test simulating fire-fighting operation. CO_2 discharges from nozzles A and B, and also actuates pressure trips, allowing hatches C and window D to close. Fire is shut out of the tank—isolated from the rest of the plant.

Large quantities of volatile solvents go into the manufacture of printing inks at Shellmar Company, Mt. Vernon, Ohio. It's a fire hazard calling for thorough protection and fast action. That's why Shellmar turned to Kidde!

Here the *Kidde** System does a double job. It can put fire out in a matter of seconds, by flooding the room with fast-acting, non-damaging carbon dioxide (CO_2). And it isolates the fire to prevent any possibility of spreading even during the brief extinguishing period.

System is completely automatic in action—on guard at *all* times. It is self-contained—requires no additional power source.

That's just one of the ways in which *Kidde* equipment can be adapted to specific hazards. Whatever *your* fire-protection problem, a Kidde representative will help you.

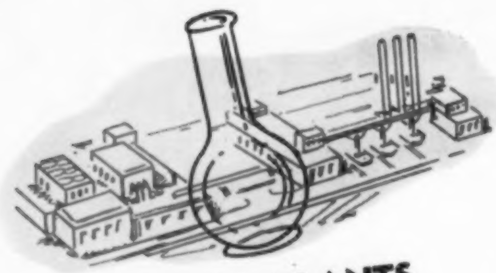
When you think of CO_2, call Kidde!

*Also known as "LUX"

The words "Kidde" and "Lux" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Kidde

Walter Kidde & Company, Inc. · 828 Main Street, Belleville 9, N. J.



A CONSTRUCTION SERVICE

for YOUR NEW PLANT *or for* PLANT EXPANSION

The services of this organization . . . with eighty-nine years' experience behind it . . . are geared to speed and economy in all types of industrial construction. These services are available to prospective clients, supplemented with equipment facilities essential to on-time completion of successful construction contracts.

A partial list of completed construction projects would include chemical plants, oil refineries, pulp and paper mills, industrial building of all kinds, heavy foundations, bridge substructures, piers and quay walls.

Regardless of the nature of your construction project, it will be to your advantage to discuss it with Merritt-Chapman & Scott.

MERRITT CHAPMAN & SCOTT CORP.

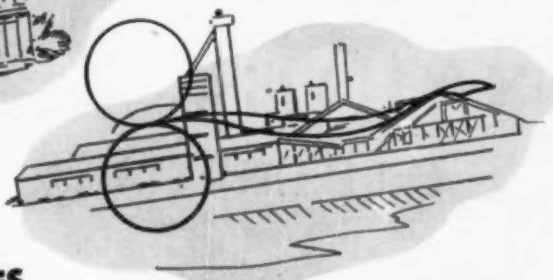
GENERAL OFFICES: 17 BATTERY PL., NEW YORK 4, N. Y.

New London, Conn. *Cleveland, Ohio*

A Service that

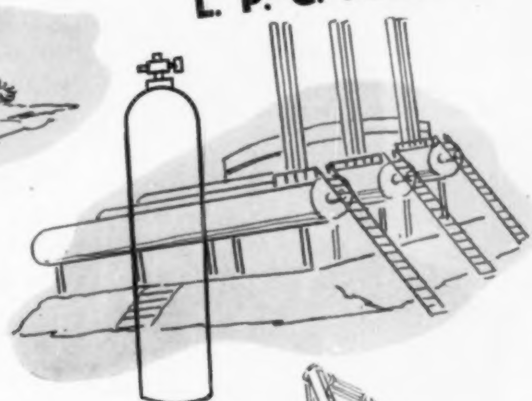
BOILER PLANTS

PAPER PLANTS



RESEARCH LABORATORIES

L. P. G. PLANTS



TYPICAL COMPANIES

We have served:

Alabama Pulp & Paper Co.
Allied Oil Co. Inc.
Amalgamated Phosphate Co.
American Cyanamid Co.
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Atlas Portland Cement Co.
Atlas Powder Co.
Bedford Pulp & Paper Co.
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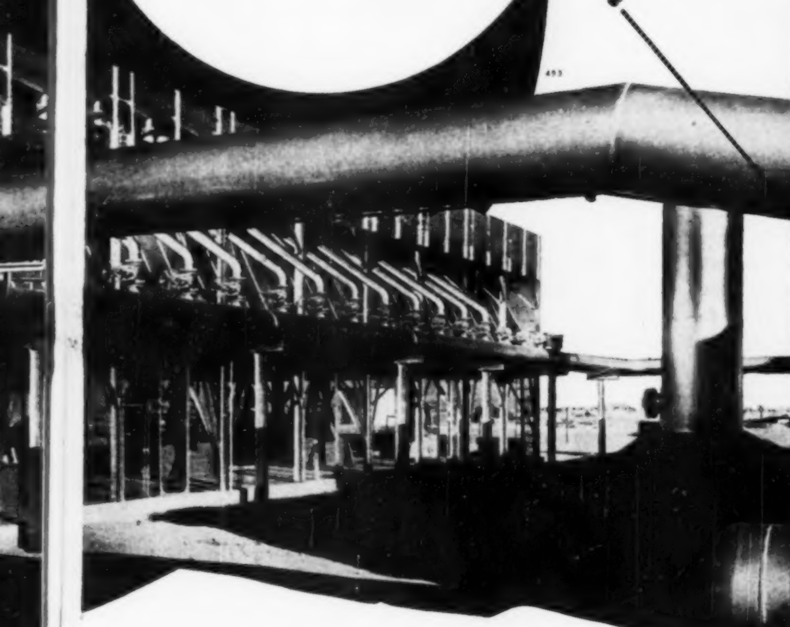
E. I. du Pont de Nemours & Co.
General Chemical Co.
Gibraltar Corrugated Paper Co. Inc.
Grasselli Chemical Co.
Hewitt Rubber Co.
Liberty Paper Co.
Marquette Cement Mfg. Co.
Merck & Co.
Mutual Chemical Co.
National Sugar Refining Co.
Parsons Paper Co.
Perth Amboy Chemical Co.
Phosphate Mining Co.
Proctor & Gamble Co.
Rayonier Inc.
Richfield Oil Co.
Southland Paper Mills.
Standard Oil Co. of New Jersey
Standard Wholesale Phosphate & Acid Works
Texas Co.
Tide Water Oil Co.
Union Bag & Paper Corp.
United Oil Co.
Vacuum Oil Co.

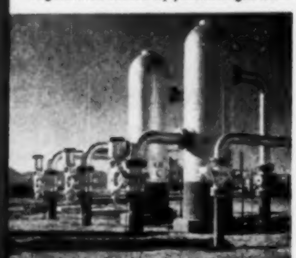
encompasses all Industry



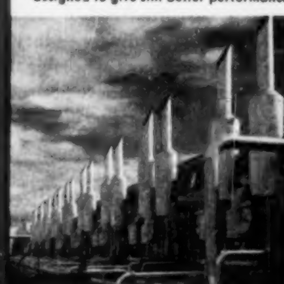
Fluor Aerator cooling towers have distinctive economy features and are most practical in certain cooling applications.

Fluor Counterflo induced-draft cooling towers are a standard of industry for most water-cooling applications. They deliver "colder water cheaper."

Fluor pulsation dampeners remove destructive vibrations and instrument irregularities caused by pulsative gas flow.



The Fluor gas cleaner, already well-known for efficient cleaning, has been redesigned to give still better performance.

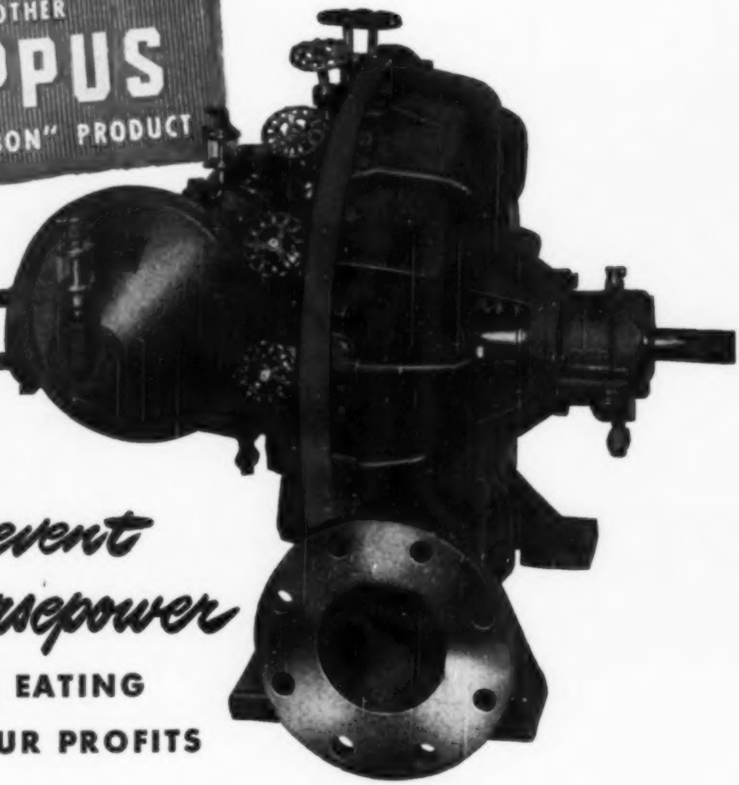


Fluor mufflers, redesigned to incorporate pulsation-dampener principles, reduce exhaust-line noises to less than the mechanical noises of the compressor room.

ANOTHER

COPPUS

"BLUE RIBBON" PRODUCT



Prevent Idle Horsepower

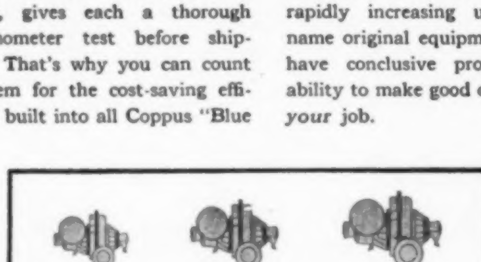
FROM EATING INTO YOUR PROFITS

Paying for a larger turbine than you need is a waste of money you can easily avoid. Coppus "Blue Ribbon" Turbines are designed to meet small-power requirements exactly. Made in six frame sizes — fractional to 150 hp, and priced accordingly — they're hard-working, smooth-running, always dependable... the logical, economical drives for your pumps, blowers, fans and similar equipment.

Coppus precision-builds these rugged performers, checks their close tolerances with Johansson blocks, gives each a thorough dynamometer test before shipment. That's why you can count on them for the cost-saving efficiency built into all Coppus "Blue Ribbon" products — blowers, ventilators, gas burners, etc.

Since 1937, over 85% of all orders for Coppus Turbines have been repeat orders. Add their rapidly increasing use on top-name original equipment and you have conclusive proof of their ability to make good on the job — *your* job.

Send for Bulletin 135-10
COPPUS ENGINEERING CORPORATION, 164 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.



pick and shovel days are over

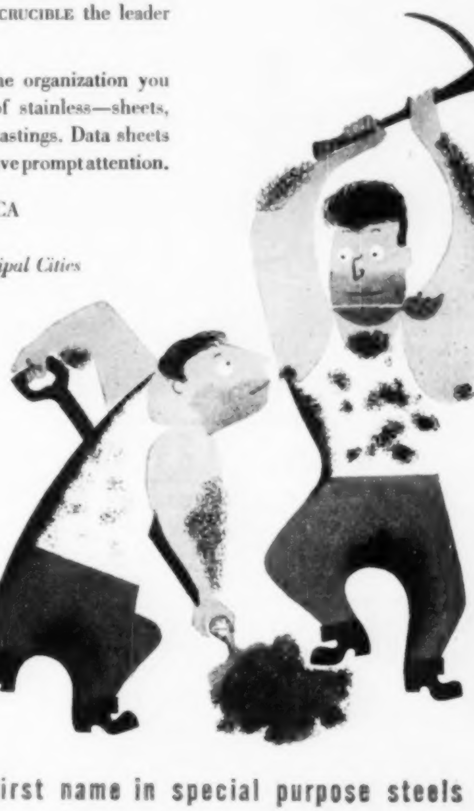
for stainless sheet and strip

Bull-dozers and steam shovels ended pick and shovel methods in earth moving. So modern strip mill facilities banished pick and shovel techniques in rolling stainless sheet and strip. Climaxing this progress, CRUCIBLE, a *specialty steel* producer for half a century, has built an $18,000,000 mill at Midland Works *specifically* for rolling stainless steel—the *first mill* that has ever been built to take complete advantage of the *best* in stainless rolling practice.

You would expect this of CRUCIBLE. You would expect that the top organization in the *specialty product* field would make stainless as a specialty—and you would be right. Here at Midland, hot and cold rolled stainless sheet and strip are made in widths from ½″ to 50″ inclusive, in all gauges, grades and finishes, with the same precise quality control that has made CRUCIBLE the leader in special service steels for generations.

Moreover, with Trent Tube Co. joining the organization you can now turn to CRUCIBLE for *every* type of stainless—sheets, plates, strip, bars, tubing, forgings, wire and castings. Data sheets are available for all grades. Your inquiries will have prompt attention.

CRUCIBLE STEEL COMPANY OF AMERICA
405 Lexington Ave., New York 17, N.Y.
Branches, Warehouses and Distributors in Principal Cities



CRUCIBLE first name in special purpose steels

hot and cold rolled **STAINLESS SHEET AND STRIP**

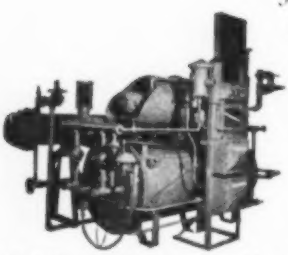
STAINLESS • HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS

Pure Nitrogen (99%+) at 1/10 your present cost!

If you have Kemp equipment, skip the rest; you've *got* rock-bottom cost right now!

If you're buying bottled gas, think hard about the savings to be effected by making your own gas.

Kemp Nitrogen Generators will give you 99%+ Nitrogen, free of CO_2 and H_2S, dried to dew points as low as −60° F.



8000 cfh Kemp combustion unit used in conjunction with Kemp Nitrogen producer. Yields 88% Nitrogen, 12% CO_2. Kemp Scrubber, in subsequent operation, eliminates CO_2 and leaves 99%+ Nitrogen.

Make your own nitrogen . . . automatically . . . dependably . . . free of maintenance costs for years . . . at a tenth to a sixth the cost of bottled nitrogen . . . with a Kemp Nitrogen Generator.

Ask to see a Kemp engineer. There's one not far from you . . . or send the coupon for the NEW Bulletin No. I-10.

The C. M. Kemp Manufacturing Co.
405 East Oliver Street
Baltimore 2, Maryland

☐ Please send me your NEW Bulletin No. I-10 on Inert Gases.

☐ Please send a Kemp representative in to see me.

Name ....

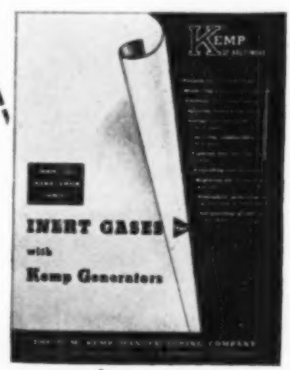
Company ....

Street ....

City .... Zone ....

State ....

DCE 8



KEMP OF Baltimore

PRECISION CARBURETORS. BURNERS FOR INDUSTRIAL HEAT CONTROL. FIRE-CHECKS AND OTHER SAFETY DEVICES. ATMOSPHERE GENERATORS. INERT GAS PRODUCERS. ADSORPTIVE DRYER SYSTEMS FOR PROCESS CONTROL.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Compare it on ANY count

It's DOUBLE safe!

With Type E turbines, you can be doubly sure of protection against overspeed.

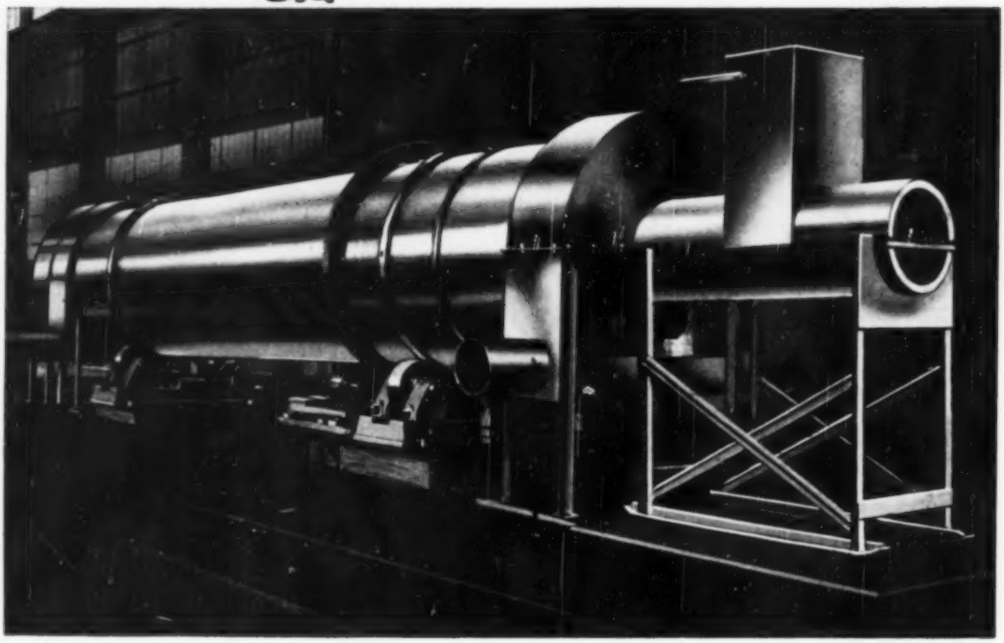
A sensitive, powerful centrifugal-weight governor, enclosed in a specially shaped housing, provides extremely accurate speed control.

However, if for any reason the governor loses control, Type E *dual* protection takes over. A corrosion-resistant, spring-restrained weight, mounted in the governor hub, strikes a trip linkage . . . instantly closes the governor valve and an independent steam inlet butterfly valve. Steam is cut off positively . . . danger is avoided.

Dual protection is but one of the many significant features of Type E turbines. We invite your comparison on *any* count. Ask your nearby Westinghouse office for 20-page book B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50499-A

Westinghouse
TYPE E
Turbines

for each Drying Operation
there's always one way that's best



Traylor
ROTARY DRYERS
KILNS · COOLERS · FEEDERS
GYRATORY · JAW AND REDUCTION
CRUSHERS · CRUSHING ROLLS · MILLS

A TRAYLOR LEADS TO GREATER PROFITS

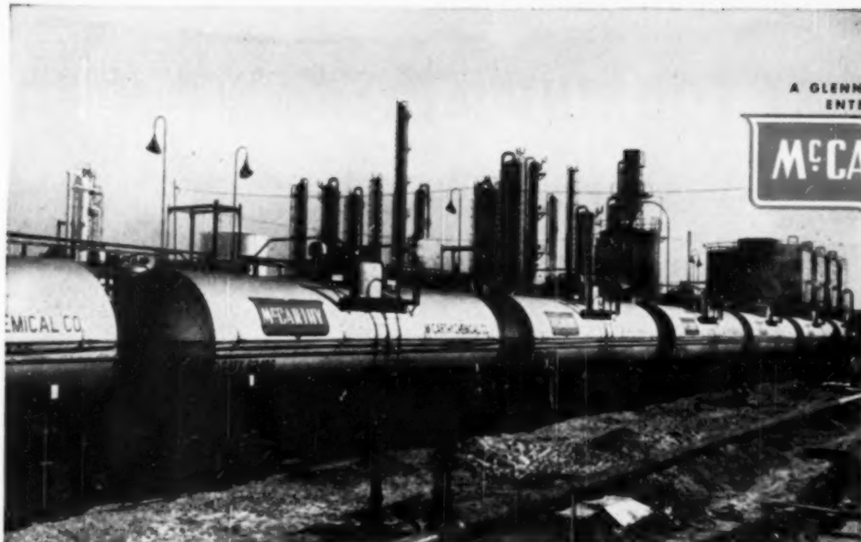
For almost half a century, Traylor Rotary Dryers have been proving that the *right* equipment on the *right* job will extract greater profits from any drying operation.

You will find the *right* dryer for your job among the several variations of the two distinct types built by Traylor. And you can rest assured that its design has already been proven by many efficient installations. Miles of Traylor Rotary Dryers, Kilns and Coolers in use all over the world testify to Traylor's skill in designing and building rotary equipment that's *right* for the job. If you have a drying problem, contact Traylor today.

TRAYLOR ENGINEERING & MANUFACTURING CO.
171 Mill Street, Allentown, Pa.
Sales Offices: New York, N. Y., Chicago, Ill., Los Angeles, Calif.
Canadian Mfrs: Canadian Vickers, Ltd., Montreal, P.Q.

A GLENN McCARTHY ENTERPRISE

McCARTHY



Loading Formaldehyde in the 10,000 gallon tank cars operated by McCarthy. Each car is especially lined and insulated.

Time to Talk '50 with McCarthy

Chemical process industries are planning ahead, checking 1950 contract needs, looking to the McCarthy Chemical Company to meet those requirements from the predictable volumes of primary and intermediate chemicals flowing today from the new McCarthy unit at Winnie, Texas.

Assured supplies of petro-chemicals are made possible by the unique McCarthy "flow-chart" — a production cycle that begins and ends with McCarthy-owned and operated facilities and resources that provide unlimited reserves of natural gas, a supervised gathering system and the fully controlled processing of hydrocarbons.

From well to market, this steady and uninterrupted flow of raw materials for plastics, dyes, explosives, paints and other chemical applications is helping meet today's demands efficiently, economically, promptly.

Now it's time to talk '50 with McCarthy. Look to McCarthy Chemical Company for your 1950 contract requirements—consult McCarthy about your needs. Write, wire or call today.

- 37% Inhibited Formaldehyde
- 37% Uninhibited Formaldehyde
- Methanol
- Propane
- Acetaldehyde
- Fuel Oils
- Butane
- Gasoline
- Kerosene

New Horizons in Hydrocarbons

McCarthy producing companies are planning ahead with industry, exploring New Horizons in Hydrocarbons through more economical, more efficient processes, conserving more and more of our valuable natural resources by converting yesterday's wastes into today's valuable raw materials.

McCARTHY CHEMICAL COMPANY

SHELL BUILDING — HOUSTON, TEXAS TELETYPE NO. 181 PHONE: PRESTON 7204

Schlieren photograph of shock waves in supersonic air stream.

Moisture would upset flow lines and form fog, spoiling visibility

Over 4,000 miles per hour! Testing for such a speed is possible in the wind tunnel recently completed at Los Angeles as part of North American Aviation's progressive research policy. Air is *drawn* through the test section by sudden release of a vacuum, developing supersonic speeds for a 15 to 20 second period.

That air must be DRY. Otherwise, moisture condenses at the low temperatures reached in the test section. Fog forms and blinds the observer. Moisture causes a condensation shock, setting up erroneous forces. Two Lectrodryers, working in series as a team, do that DRYing. Dewpoints of −42° F. are obtained.

Lectrodryers are performing similar service in dozens of industries, in hundreds of plants all over the world; DRYing air, gases and organic liquids—handling minute or tremendous volumes —at atmospheric pressure or up to 3,000 psi.

Bulletin 216 shows you these Lectrodryers at work. For a copy, or for help on your DRYing problems, get in touch with Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

Cutaway drawing of North American Aviation's new supersonic wind tunnel and its components. The two Lectrodryers which DRY the air as it goes into the storage tank appear at the lower right corner.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U.S. PAT. OFF.

Richardson Model J-40 Synthetic Resin Scale complete with top hopper and Bindicator, screw feeder and drive.

If you can't figure out why profits on processed chemicals are shorter than you like, take a look at your batching. Perhaps spoiled mixtures are taking a bigger bite than you think. That is, unless you're using Richardson Automatic Bulk Weighing Scales.

A battery of Richardson "Class 40" Scales, automatically weighing and proportioning or blending such varied ingredients as coke, soda ash, ground lime, fly ash, silica, carbon black, rubber pellets, soap chips, ores, etc., eliminates chance of spoiled mixtures by maintaining constant and positive control over the proportions of each ingredient to insure uniformity in end products. A single unit is ideally suited for weighing one kind of material from storage to process.

The "Class 40" is a totally enclosed self-contained, dust-tight unit designed for optional feeding by belt, screw, air slide, or vibrating feeder. Corrosion-resistant construction is provided when handling corrosive chemicals. Weight indicator proves accuracy to fraction of one per cent. Remote control box provides control over material supply and processing cycle. The "Class 40" is adaptable to bagging or weighing to containers.

Let a Richardson representative show you how a Richardson batching set-up in your plant can help you cut down operating costs and boost profits.

Bulletin No. 1449 describing the "Class 40" scale is just off the press. Send for your copy.

5861

ONE OF MANY TYPES OF RICHARDSON SCALES FOR MATERIALS HANDLING BY WEIGHT.

RICHARDSON SCALE COMPANY
CLIFTON, N. J.

Atlanta • Boston • Buffalo
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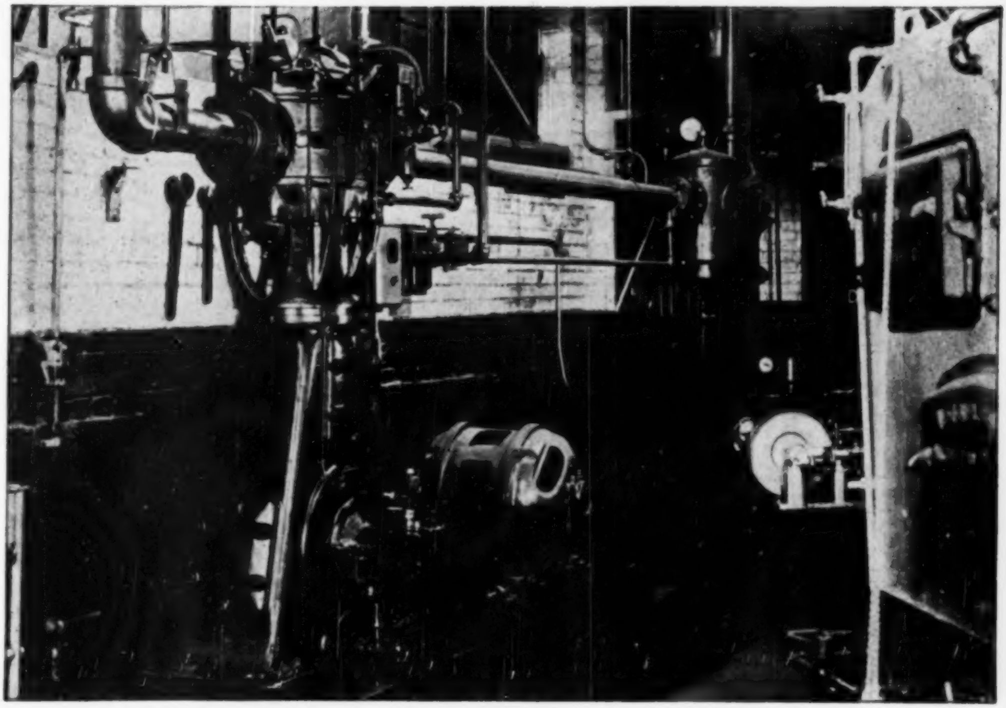
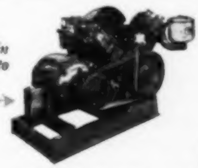


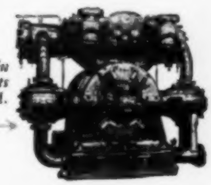
SAVE VALUABLE SPACE WITH THE EFFICIENT

JOY WG-9 HEAVY DUTY AIR COMPRESSOR

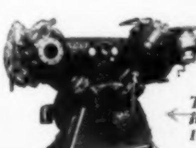
The vertical design and small base of the JOY WG-9 Compressor mean great savings in valuable floor space. Built in eleven sizes from 153 to 822 CFM, the WG-9 is designed for continuous heavy-duty service... features the exclusive JOY "Dual-Cushion" valves for top efficiency and lowest-cost operation. ● JOY builds the most modern compressors available for either centralized or decentralized air supply—*write for Bulletin.*

The JOY WL-80, in nine sizes from 81 to 590 CFM.





The JOY WN-114, in single or twin units from 1092 to 7312 CFM.



The JOY WN-112, in sizes from 378 to 1828 CFM.

Consult a Joy Engineer

W&D 12049

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

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22nd EXPOSITION
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CHEMICAL INDUSTRIES

ESTABLISHED 1915

GRAND CENTRAL PALACE
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You'll get hundreds of worthwhile ideas here . . . for research endeavors . . . for solving present material, equipment and production problems . . . for reducing operating and maintenance costs . . . for improving products . . . for modernizing and expanding plant facilities. Over 350 manufacturers will be on hand to show, demonstrate, and explain better, faster, and less costly ways to perform your chemical processes . . . to help fit the latest equipment, methods, and practices into your present operations or future plans.

For over 30 years, leaders in every phase of the chemical industries have been keeping abreast of newest developments through this great exposition. You, too, can benefit. Don't miss it.

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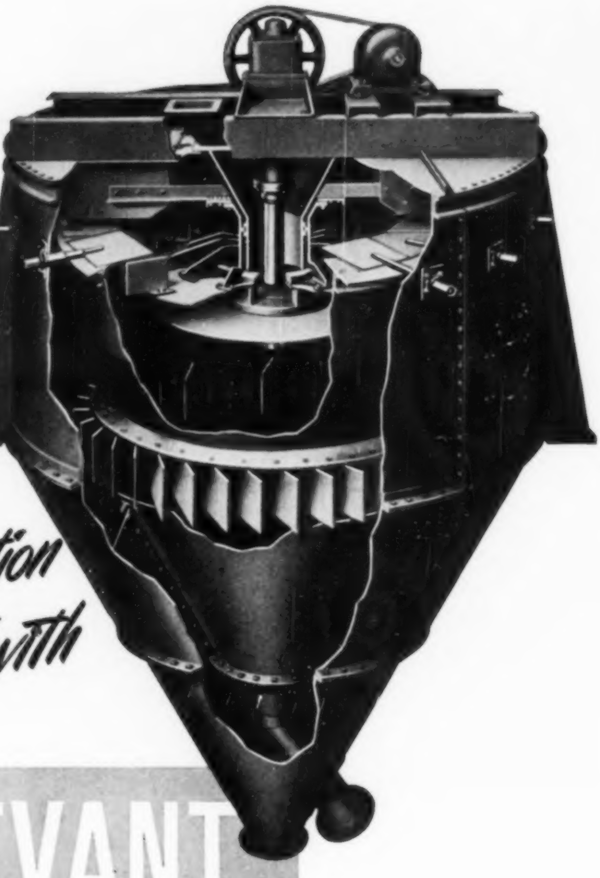
Management International Exposition Co.



Increase Production of Fines by 300% with

STURTEVANT
Centrifugal Air Separators

ACCURATE SEPARATION OF FINES FROM 40 TO 325 MESH AND FINER... OUTPUT CAPACITY FROM ¼ TO 50 TONS PER HOUR

Records prove that Sturtevant Air Separators cut separation costs of various materials by as much as 300%. In addition, they provide additional economies by reducing power costs up to 50%. That's why you'll find hundreds of these efficient separators in all types of industries.

Ruggedly constructed of quality materials, Sturtevant Air Separators keep on working day after day with minimum maintenance. They are available in many sizes from ¼ to 50 tons per hour output.

Investigate cost-cutting Sturtevant Air Separators for your plant. Write for catalog and information, today.

STURTEVANT MILL COMPANY
100 Clayton St., Boston 22, Mass.
Designers and Manufacturers of
CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS
MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS

There's a big DIFFERENCE in Permanent Magnetic— SEPARATORS

TWINS? I should say NOT!

Remember-You get these advantages when you specify *Eriez* permanent magnets-

1. Superior Cleaning Ability.
2. No Wiring for Electric Current Needed . . . No Coils to Burn Out.
3. Cooler Running . . . No Loss of Magnetism Through Heating Up.
4. Not Affected by Moisture or Wet Materials.
5. No Operating Costs . . . First Cost is Last Cost.
6. Minimum Installation Cost.
7. Simple . . . Powerful . . . Permanently Magnetized.
8. Uninterrupted Operation . . . Top Efficiency Always.
9. Easily Installed in Original Equipment.

A big difference in permanent magnetic separators? Of course! And that difference shows up on the design engineer's drawing board. Design "know-how", more than any one factor, is instrumental in producing a permanent magnetic separator of maximum magnetic strength. For example—these two magnets—they weigh the same and to outward appearances look exactly alike—But one is four times more powerful than the other. Why? Because each grade of alnico requires a different design approach. Each is very critical with respect to design, in obtaining maximum external energy. In this illustration one magnet was not correctly designed to the alnico material while the other was. Hence the big difference in strength.

Eriez, with its many years leadership in permanent magnet design, knowledge of materials, and methods of energizing, plus a design department devoted exclusively to the development of better permanent non-electric magnetic separators, is best qualified to give you the finest product available, specifically designed to do the separating job you need. In addition, application engineering service is available with every job. Representatives in all principal cities.

Write, wire or phone Eriez Mfg. Co. Erie, Penna.

Pioneer of PERMANENT Magnetic Separation

P $\frac{1b}{2}$ See our catalog in Sweet's

See our catalog Sweet's Process Industries File.

Ask for Catalog No. 12

ERIEZ MANUFACTURING COMPANY

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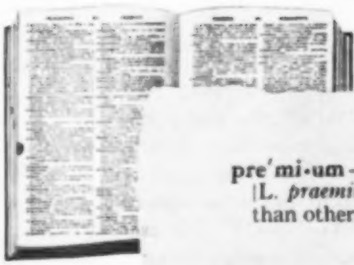

pre'mi·um — (prē'mi·um; 159), *n.; pl.* PREMIUMS (-umz). [L. ***praemium***, orig., what one has got before or better than others.

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Your product is *important* to you and to your customer. So . . . don't just put it in a bag . . . put it in a Chase Bag — the premium container for your premium product — the container that gives you all 6 of these important advantages:

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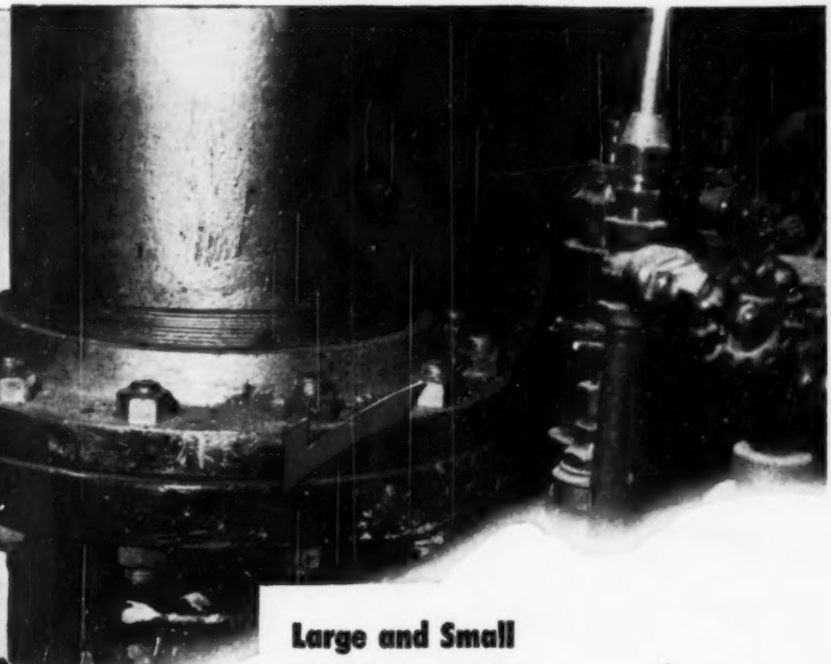

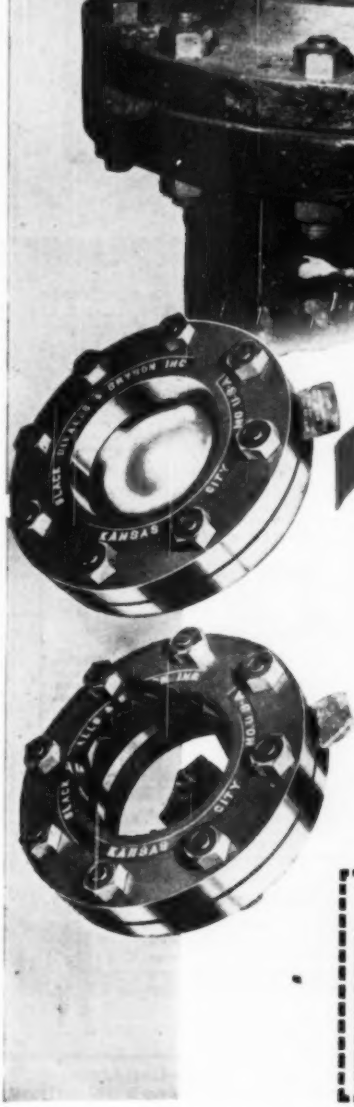

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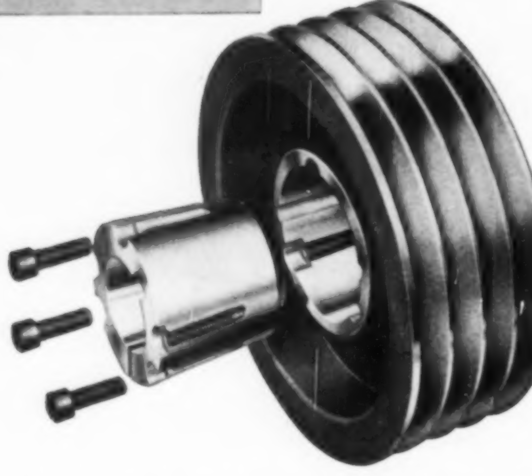
Holds fast to the shaft with firmness equivalent to a shrunk-on fit



No flange — no collar. Easy on, easy off. Slip it on and tighten while sighting

Stocked in complete range of sizes in Dual Duty (A and B); B, C and D grooves

A Great, Time-Saving Development—

TAPER-LOCK

Trade Mark

V-BELT SHEAVE

This is one of the century's biggest developments in power transmission equipment—another Dodge "first." Simpler, tighter-fitting, truer-running, infinitely easier to handle. Saves installation time and results in neater applications—in the plant or on your product.

Dodge's sole business is to "get the power through"—smoothly, steadily, economically. To succeed in this business Dodge has developed *many* products that are outstanding in the field of mechanical power transmission. Your Transmissioneer, the local Dodge Distributor, is equipped to give you valuable information on new and better ways to transmit power.

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OTHER DODGE "FIRSTS"

Dodge-Timken Bearing. 4 basic types in a vast range of sizes.

Taper-Lock Flexible Coupling. Ready to install without reboring.

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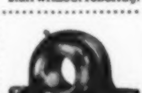

"SC" Ball Bearing with new Neoprene metallic-backed seals.

DODGE

of Mishawaka, Ind.

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Look for the name of the Transmissioneer, your local Dodge distributor, under "Power Transmission Equipment" in your classified telephone directory.

NAME PLATES — FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

7 HOOKER ACID CHLORIDES

You should know . . .

As a major producer of high quality chlorine, Hooker is able to manufacture acid chlorides of high purity and uniformity. If you are working with dyestuffs, plasticizers, pharmaceuticals, lubricants or in other processing fields where you require good quality acid chlorides, you should check into these Hooker products.

The acid chlorides Hooker can supply are listed below with brief information about their physical and chemical characteristics and their uses. More complete information is given on individual Technical Data Sheets available when requested on your business letterhead. Hooker's Technical Staff is also ready to work with you on the application of Hooker chemicals to your specific problems.

PRODUCT *Chemical Formula and Molecular Weight*	DESCRIPTION AND USES
Metanitrobenzoyl Chloride $NO_2C_6H_4COCl$;185.5	Yellow to brown liquid partially crystallized at room temperature. Last crystal point 28° to 31°C. Manufacture of dyes for fabrics and color photography; intermediate in preparation of pharmaceuticals.
Paranitrobenzoyl Chloride $NO_2C_6H_4COCl$;185.5	Yellow crystalline solid. M.P. 70°C minimum. Manufacture of novocaine, procaine hydrochloride; dyestuffs.
Acetyl Chloride CH_3COCl;78.5	Clear, colorless to pale yellow liquid. Dist. R. 2.5° incl. 51°C. To introduce acetyl group into organic compounds. Manufacture of intermediates, dyes, and pharmaceuticals.
Benzoyl Chloride C_6H_5COCl;140.5	Clear, colorless liquid. Boiling point 198°C. As a highly reactive acid chloride, it may be used to introduce the benzoyl group into organic compounds, especially through Friedel-Crafts reactions. It is used in the manufacture of synthetic perfumes, pharmaceuticals, dyes and resins.
Phosgene (Carbonyl Chloride) $COCl_2$;98.9	Liquified gas. F.P. −126°C., B.P. 8.2°C. Manufacture alkyl and aryl chlorocarbonates and dialkylcarbonates; dye intermediates; metal chlorides and anhydrides; pharmaceuticals; perfumes.
Sulfuryl Chloride SO_2Cl_2;135.0	Light yellow liquid. B.R. 2° incl. 69.5°C. Reacts with organic acids to form other chlorides and anhydrides. Chlorinating agent for chlorophenol and other chlorination reactions in organic synthesis.
Thionyl Chloride $SOCl_2$;119.0	Clear, pale yellow to red liquid. Refined Grade, 97.5% min. $SOCl_2$; Technical Grade, 93+%. Manufacture of organic acid chlorides and anhydrides, alkyl chlorides from corresponding alcohols. It may be used to introduce sulfur alone or in combination with oxygen.

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HOOKER ELECTROCHEMICAL COMPANY

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Penberthy Ejectors

(ASPIRATORS, EDUCTORS, EXHAUSTERS, MIXERS, ETC.)

Have Many Advantageous Uses in the Chemical and Process Industries

A simple jet pump operated by steam, water or air, the Penberthy Ejector has no moving parts and requires no lubrication. It is very unlikely to get out of order and wear is not appreciable. Other advantages of this jet type pump are that it is practically noiseless, very reliable, compact, convenient and has low initial cost.

Widely used in the chemical and process industries, Penberthy Ejectors are made from ½" to 6" pipe sizes with screwed or flanged connections. They are made in bronze, iron and a wide variety of materials that successfully withstand corrosion, contamination and high temperatures. Special units are designed and manufactured to meet unusual conditions. Your inquiries are solicited. Write for Catalog 34.

PENBERTHY WATER HEATER

Penberthy XL-32 Water Heater (Open Tank Type) uses steam to heat water or other liquids to any temperature up to boiling (212° F) . . . quietly and without surging or pounding. Operating steam pressures range from 3 to 140 psi at the heater nozzle. Made of high grade bronze. Sizes are from ½" to 2". Write us regarding special heaters for unusual conditions.

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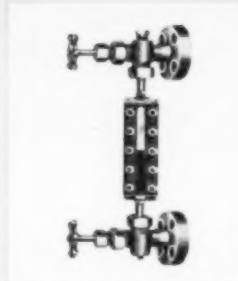
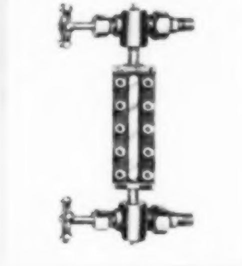
PENBERTHY REFLEX and TRANSPARENT Liquid Level Gages



REFLEX

Due to "Reflex" principle, liquid always shows black and empty space white. Liquid level is indicated instantly and unmistakably. Made in any length desired of temperature resisting alloy steel for high pressure and temperature service. Conforms with API and ASME requirements. Ask for new Catalog 35.



TRANSPARENT

Glass front and rear permits observation of color and density of liquids under high pressures and/or temperatures. Highest quality—made of temperature resisting alloy steel in any length required. Conforms with API and ASME requirements. Ask for new Catalog 35.

PENBERTHY INJECTOR COMPANY

DETROIT 2, MICHIGAN

Established 1896 Canadian Plant, Windsor, Ontario

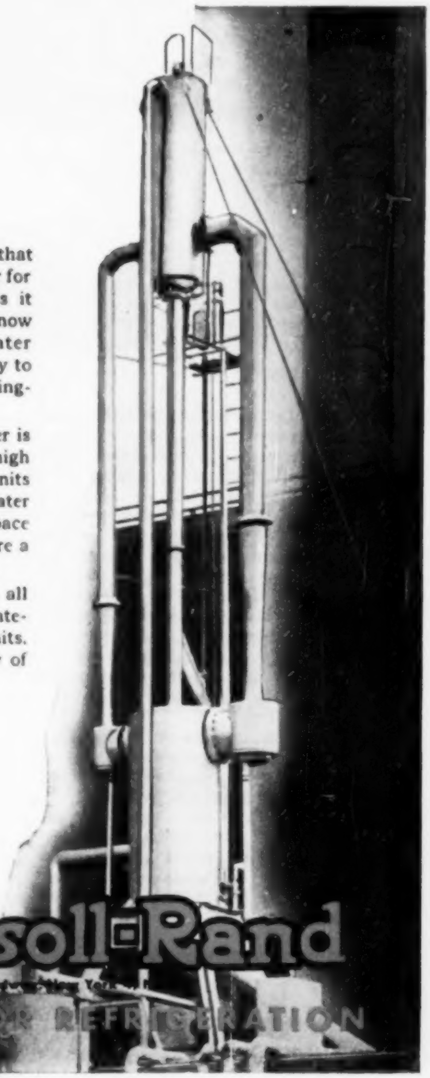
PENBERTHY PRODUCTS

How's your Cold Water Standing the Hot Weather?

If hot weather means that the supply of chilled water for your plant isn't as cold as it should be, then you'll want to know more about Ingersoll-Rand Water Vapor Refrigeration. It's the simplest, most dependable way to insure your plant against the seasonal problem of rising cooling-water temperatures.

In Ingersoll-Rand Water Vapor Refrigeration units, water is the only refrigerant. It is cooled by direct evaporation in a high vacuum created by steam jet boosters. Capacities for single units range from 20 to 1200 tons of refrigeration for chilled water temperatures down to 40°F... These units solve their own space problem too, as they can be mounted outdoors. They require a minimum of foundation and are entirely self-supporting.

If you want full details on the economy of operation at all loads—the safety—the ease of operation—and the low maintenance cost of Ingersoll-Rand Water Vapor Refrigeration units, ask the nearest Ingersoll-Rand branch office for your copy of bulletin No. 9143-A.



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COMPRESSORS
CONDENSERS
TURBO-BLOWERS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES

19-13

Ingersoll-Rand

WATER VAPOR REFRIGERATION

SERIES "K" (self-priming) TYGON PAINT is a new companion coating to the TP Series (multiple coat) Tygon Paints. Series "K" Tygon Paints are designed primarily as maintenance protective coatings for general use around chemical plants. They possess the basic resistant properties of the "TP" Series of Tygon Paints, standing up well under most acids, alkalies, oils, greases and alcohols. Moisture resistance is excellent.

Series "K" Tygon Paints are easier to apply. The average maintenance employee who can use a brush or spray gun can apply Series "K" Tygon Paint. No unconventional surface preparation is required; no separate priming material is used. Spray or brush on two or three coats of Series "K" and you'll have low-cost, long-lived protection against fumes, gases, acid spillage, high humidity, etc.

Series "K" Tygon Paint dries to the touch within a few minutes, resulting in minimum down time for equipment. While Series "K" Paints are inflammable in the wet state, the dried film is slow burning and will not support combustion.

Series "K" Tygon Paints can be applied equally well to metal, wood or concrete. They may be applied over well oxidized red lead or oil base coatings though a test application over a small area is usually advisable to be sure the solvents in Series "K" will not "lift" or wrinkle the old paint. Series "K" Paints can be applied over any surface previously painted with either the Series "K" or Series TP Tygon Paints, as well as over other coatings using a solvent type vehicle.

Series "K" Tygon Paints are priced no higher than top quality oil-base industrial coatings; but the life-year cost of this new series of vinyl coatings is substantially less.

SERIES "K" TYGON PAINTS do not replace the present line of Tygon Paints which are known as the "TP" Series. For severe corrosive conditions, where intermittent immersion of the coated surface exists, for maximum long-run economy, the "TP" Series of Tygon Paints should be specified. For general maintenance use under corrosive conditions, for simplicity in application, for low applied cost; specify Series "K" Tygon Paint.

Have Your Own Maintenance Staff Test Series 'K' Tygon Paint

We'll be happy to send you, without cost, samples of the new Series "K" Tygon Paints for test in your own plant. Write Plastics & Synthetics Division, The U. S. Stoneware Co., Akron 9, Ohio.

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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

August 1949, Volume 56, Number 8

Success: on all six burners

FULL-SCALE TEST—The coal gasifier at the Louisiana, Mo., Fischer-Tropsch plant run by the Bureau of Mines has come through its first full-scale test with flying colors. Probably the largest unit ever installed for direct production of synthesis gas from finely powdered coal and oxygen, the gasifier ran 4 hr. with all six of its burners operating at design capacity and with gasifier temperatures averaging about 2,200 deg. F. The 4-hr. test was part of a 10-hr. period of operation.

NEW MODEL—A new type continuous model installed by Koppers, the Bureau's gasifier does not require coking coals.

SIGNIFICANCE—Gasification is the toughest cost and process problem to be licked before competitive gasoline and oil can be made from coal by either of the two basic processes employed at the Louisiana demonstration plant. In the Fischer-Tropsch process, the synthesis gas obtained by coal gasification—a carbon monoxide and hydrogen mixture—accounts for about 60 percent of the cost of the liquid fuel products. In the coal hydrogenation process, the hydrogen obtained thereby now represents 40 percent of the product cost. Hence a low-cost gasification method applicable to all types of coal is imperative.

HOW IT WORKS—How does the gasifier work? First, coal is crushed, pulverized and dried. Next, this "dust," suspended in oxygen and accompanied by superheated steam, is fed into both ends of the gasifier, a refractory-lined horizontal steel cylinder with interior dimensions of 6½ by 9 ft. There the conversion to synthesis gas takes place at 2,500 deg. F.

CAPACITY—In a 24-hr. period the unit gobbles up 28 tons of coal, 24 tons of oxygen and 35 tons of superheated steam, produces some 2 million cubic feet of raw synthesis gas.

SYNTHESIS GAS—In this first test Bureau of Mines engineers got 16 percent carbon dioxide, more than they bargained for. But, as they become familiar with the operating characteristics of the new gasifier, they hope to reduce the carbon dioxide content and to obtain more and better synthesis gas. Balance of the product was made up as follows: carbon monoxide, 37 percent; hydrogen, 42 percent; nitrogen, 4 percent; and miscellaneous gases, 1 percent.

OTHER UNITS—The gasifier is the second of the plant's five units to be completed. A Linde-Fränkl oxygen unit has been in operation for several months. It is expected that the remaining units for gas purification, hydrocarbon synthesis and product refining will be up and running during 1950.

Court battle blocks disposal of GAF

MONKEY WRENCH—When Federal Judge Alexander Holtzoff authorized participation of Remington Rand in the international suit over the stock of General Aniline & Film Corp., he threw a monkey wrench into plans of the Office of Alien Property for a cash settlement out of court with I.G. Chemie. Both I.G. Chemie and the Swiss government, as well as OAP, had been anxious to settle out of court. Such a settlement would have given the U. S. clear title to GAF and it would also have paved the way for an early sale.

CASH ON THE BARRELHEAD—Representatives of the Swiss government have been in Washington discussing the GAF case. The Administration had favored a cash settlement out of court for "a nominal sum"—say, 10c. on the dollar. Others had estimated that the Swiss might get from 15 to 75 percent of the proceeds of an ultimate sale in return for a clear title to GAF. Horse trading had been going on for some time.

SWISS CLAIMS—Up to now, OAP has been blocked from selling the $100 million chemical company because of a suit by I.G. Chemie, now known as Interhandel A.G. This Swiss outfit claims: (1) it is the real owner; and (2) that it is not and never was an enemy alien, and thus is entitled to return of more than 2,500,000 shares of GAF stock, a 97 percent interest, seized by the U. S. government 7½ years ago.

OTHER CLAIMANT—Meantime, Remington Rand, a 3 percent minority stockholder in GAF, had contracted with I. G. Chemie to buy the GAF stock for $25 million if Chemie recovered it. Judge Holt-

(Continued on page 70)

zoff held that I.G. Chemie's contract with Remington Rand obligated the Swiss concern to try to regain the stock if possible by fighting it out in court. This might take years. Of course, it would rule out any cash settlement.

Funny thing is that Remington Rand's contract with I. G. Chemie is a verbal one, not in black and white. And Chemie hotly denies that any such contract was made.

DISPOSAL LAW—The law on disposal of alien property prohibits the government from selling as long as there is any court action in which ownership of the seized property is claimed.

CLEAR TITLE FOR U. S.—Attorney General Tom Clark had turned down an earlier I.G. Chemie offer of a stock split as a method of settlement. Chemie wanted majority control. But the U. S. government was determined that no stock interest should remain with the Swiss and that the deal—if any—should provide for a cash payment to settle all outstanding claims. The government would then have been free to sell.

OPEN BIDS—The procedure originally planned called for open bids, not negotiated sale. There would have been no sale, of course, that might have been attacked as furthering monopoly in the chemical field. This ruled out as buyers such leading chemical producers as Du Pont, Dow and Eastman Kodak.

CONGRESS BALKS—The Department of Justice turned to the deal with the Swiss when it was unsuccessful in getting a bill through Congress that would permit it to sell GAF and then let the courts decide who was the rightful owner entitled to the proceeds of the sale.

COURT BATTLE—OAP boss David L. Bazelon has long been trying to free GAF for sale. His private nightmare: the prospect of a long and involved court battle preceding a final decision on I. G. Chemie's claim. The suit could take from 2 to 10 years. In the meantime, GAF would suffer from not being able to expand under private management.

Chemical companies put bite on RFC

RICH UNCLE—Chemical companies, temporarily strapped for capital, have been running to the Reconstruction Finance Corp. Nor have they been alone; other companies have been doing the same thing. That is why RFC's business has been booming.

RFC can lend any amount to anyone for any purpose for as long as 10 years at 4 percent. Right now, it is granting about three-fourths of all applications.

LOANS UP—During February, March and April of 1949, latest months for which figures are available, applications for RFC loans by industry averaged 838 a month, up about 40 percent from the monthly average for all of 1948. The dollar rise has been even sharper; borrowers are now asking for about $120 million a month—twice as much as they wanted a year ago.

Chemical companies alone have asked for 19 loans during the same three months. The total amount involved: $2,448,000.

CARTHAGE—RFC has lent Carthage Hydrocol $18.5 million for 10 years for construction of a plant to convert natural gas into gasoline. The company's owners, a group of Texas oil refiners, have chipped in a like amount plus $5 million for working capital. Carthage had found that it could not raise the money, to build the plant, reasonably by security flotation.

OTHERS—Here are a few of the smaller companies that have successfully borrowed working capital from RFC: Reasor-Hill Corp., Arkansas insecticide manufacturer, $100,000; John L. Armitage & Co., New Jersey paint, varnish and lacquer manufacturer, $50,000; Draper Soap Co. of Rhode Island, $20,000; and Delta Laboratories, California pharmaceutical producer, $10,000.

Du Pont to own all of Kinetic Chemicals?

A DICKER—Du Pont and General Motors are negotiating for the sale to Du Pont of all stock in Kinetic Chemicals owned by GM. Du Pont owns 51 percent of the capital stock of Kinetic Chemicals; General Motors, 49 percent. GM is a large purchaser of chemical products made by Kinetic.

AND ITS CONVERSE—Incidentally, when Du Pont in February 1948 sold its entire holdings of 36,497 shares of preferred stock of Ethyl Corp. at the par value of $3,649,700, General Motors purchased one-half of these shares. GM now owns 50 percent of the preferred and of the common capital stock of Ethyl Corp., which is engaged principally in the manufacture and sale of tetraethyl lead.

How big is too big?

Is bigness in business inherently monopolistic? Getting at the answer to that slippery question is going to be a prime concern of the Celler Committee as it investigates concentration of economic power.

This House Judiciary Subcommittee headed by Rep. Emanuel Celler, New York Democrat, has already begun hearings. It expects to work through the fall, perhaps come up with a report for Congress next year. The committee may continue its work for a couple of years.

(Continued on page 72)

The anti-trust action against Du Pont is likely to get a thorough airing during the committee hearings, since it typifies the government's policy of suing big corporations just because they are big. The Department of Justice seeks to break up the integration of Du Pont, General Motors and U. S. Rubber.

Other things the committee will look into: (1) the closing of loopholes that make it impossible for the government to prevent mergers that lessen competition; (2) stiffer penalties for companies convicted of restraint of trade, price fixing and other anti-trust offenses; and perhaps (3) repeal of exemptions from the anti-trust laws, such as those granted to manufacturers to fix minimum retail prices on branded products and to the railroads to make rates.

How chemicals fared in first quarter

PARED PROFITS—First-quarter profits of chemical manufacturing corporations were definitely down. In the first three months of 1949, the nation's chemical companies made $240 million, after taxes. That is off about 16 percent from the fourth quarter of 1948, about 9 percent below the corresponding quarter last year.

SALES DOWN—For the first quarter of this year sales of all chemical manufacturing corporations totaled $2,963 million. Volume was off $79 million—or 2.6 percent—from the preceding quarter. Reason: dealers held sales steady but cut down orders to work off inventories.

COSTS STILL HIGH—Net operating expenses for the first three months were $2,580 million, down only $67 million or 3 percent from the last quarter of 1948. High overhead makes for high break-even points and keeps costs from dropping as quickly as sales.

ASSETS UP—Total assets of chemical manufacturing corporations of all sizes were up about $58 million in the first quarter to about $9,423 million. An increase of $81 million in accounts receivable only partly offset by a jump in liabilities was the biggest factor in the rise.

HARBINGER—Buried in the figures is this hopeful sign: chemical manufacturing corporations were in a substantially more liquid condition at the close of the first quarter than they were at the end of 1948.

The ratio of cash and government securities to current liabilities—a standard measure of corporate liquidity—rose from 92 percent to 104 percent.

This rise reflects inventory liquidation. It also means that business is better able to meet a further drop in sales—or a sudden flood of orders if one should come along.

Two tough ones for atomic labor panel

TROUBLE-SHOOTER—The new Atomic Energy Labor Relations Panel has been called in on two atomic labor feuds.

DISPUTES—Involved are: (1) Carbide & Carbon and the AFL Atomic Trades & Labor Council at Oak Ridge National Laboratory; and (2) Monsanto and the CIO Gas, Coke & Chemical Workers at the new Mound Laboratory at Miamisburg, Ohio, near Dayton.

PANEL HEARINGS—Under the settlement plan for atomic disputes, both contractors and unions are obliged to maintain operations until the panel exhausts efforts at bringing about a settlement. Panel hearings were held in Maine near the summer home of William H. Davis, panel chairman. Any recommendations by the panel will have a strong influence on settlement terms, although neither side is committed to accepting them.

ISSUES—Both Monsanto and the CIO petitioned the panel to intervene in their dispute over the terms of their first labor contract. The company and union were about 7c. apart at the time. They also differed over union security and a no-strike clause. Monsanto had offered concessions adding up to an average increase of 15c. an hour.

At Oak Ridge, panel intervention had been requested by the AFL union. Besides wage adjustments, it sought restoration of some benefits it surrendered last year. In all, 28 issues were in dispute.

Carbide & Carbon gave the CIO an 8c. increase in June at the Oak Ridge gaseous diffusion plant.

Chemical exporters tighten belts

FEWER ORDERS—For the coming year, exporters of chemicals can look for fewer orders from Europe than they originally expected. Two things have happened to scale down Western Europe's plans for buying in the U. S.

BRITAIN'S WOES—First is the British dollar crisis, initial result of which has been a decree cutting all dollar buying by 25 percent.

CUTS IN ECA—Second was the action of Congress in slashing appropriations for ECA's second year below Paul Hoffman's requests.

IMPACT—All told, this trims originally planned purchases in the Western Hemisphere by almost $1 billion. First hit by the cut are fabricators of capital equipment. Next on the list are suppliers of industrial raw materials—this group includes many producers of chemicals.

(Continued on page 74)

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Photo by courtesy of James Graham Mfg. Co., Newark, Calif., manufacturer of Wedgewood ranges.

Each *SPEEDAIRE* unit saved $243

THE Speedaire shown here is operating a pebble mill, grinding enamel for use in the manufacture of kitchen ranges—one of two such installations at this plant.

This job would have required a conventional worm gear drive nearly three times as large as Speedaire, weighing more than twice as much. By installing the smaller, more powerful speed reducer, the company saved $243 per unit.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—giving you the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Co., 3273 East 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

DIP LIKELY—Last year Marshall Plan countries bought better than $194 million worth of chemicals from the U.S. This year exports could easily drop below that figure, despite the fact that during the first quarter of 1949 U. S. chemicals were exported at an annual clip that topped $200 million a year.

Bids sought on ammonium sulphate plant

Pakistan has called for surveys and bids on an ammonium sulphate plant. It must have an initial capacity of 20,000 metric tons and be able to expand to 50,000 metric tons a year.

Government-owned, the ammonium sulphate plant would be located in the grain-rich West Punjab.

Strongest contender for the prized bid is Power-Gas Corp., Ltd., of Britain.

L.A. all abubble over Lever expansion

As the first phase of a $55 million expansion program, Lever Bros. has started construction of a $25 million soap and food products plant on a 30-acre site 8 mi. east of Los Angeles. The new plant represents the biggest new industrial investment by private business in the history of Los Angeles County.

To employ more than 600 people, the plant will handle raw materials and finished products at the rate of 180,000 tons a year.

Glidden gets a southern drawl

The Glidden Co. of Cleveland, Ohio, is staking a claim in Dixie. Its big margarine plant near Macon, Ga., has just been completed. And on the same site Glidden plans to construct a refinery for edible oils and a paint and varnish plant. Cost will run into millions of dollars.

To show its southern hospitality, the Central of Georgia has called its new railroad station at the plant Glidden.

Du Pont stepping up nylon capacity

YARN AND STAPLE—In a program to continue into 1951, Du Pont is expanding production facilities for nylon yarn and staple. New yarn spinning and processing equipment is being installed in the Chattanooga, Tenn., plant, while facilities for staple production are being added at the Seaford, Del., plant.

NYLON SALT—Meantime, construction is under way on Du Pont's new Victoria, Tex., plant, where nylon salt is to be made by a radically new synthesis from butadiene.

PPG prexy glum on soda ash and caustic

DOWNTURN—The Columbia Chemical Division of Pittsburgh Plate Glass is operating at about two-thirds of capacity, reports H. B. Higgins, president of PPG.

SODA ASH—Sales of soda ash, one of Columbia's principal products, have been down badly since the middle of 1948. And the decline is continuing. Big factors behind this dip: (1) low production and closing of plants in the glass container industry; and (2) slackened demand from paper makers, chemical processors, textile manufacturers and other consumers of ash.

CAUSTIC—Columbia's caustic soda sales also have declined, due to lack of demand from producers of rayon, paper, chemicals, explosives and other products.

OUTLOOK—The outlook in chemicals for the rest of 1949 is not encouraging. Normally, business is lowest during the third quarter, but PPG hopes for some improvement in the fourth quarter.

Methionine: more meat on chickens

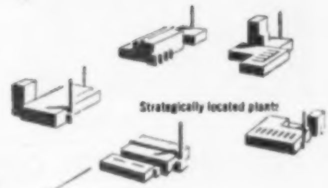
Excited clucking in hen houses across the land these days is all about Dow's new feed supplement that promises a new interest in life for chickens, new pep for hens and roosters, and the appearance of stylish stouts among poultrydom's smart set. And Dow has something to crow about: first commercial production of synthetic DL-methionine. For that matter, when Dow's new plant, now under construction at Pittsburg, Calif., goes on stream this fall it will be the first commercial unit to make any important amino acid synthetically. Dow researchers and engineers developed the new process.

Why all the fuss and feathers about DL-methionine? It is one of the amino acids vital to animal growth. Isolating the pure acid by biochemical methods, however, gives a very low yield. Hence for more than two decades the chemical has been high in cost. Most work with methionine as a nutrition supplement has been in the poultry field. Results have been most encouraging, reports Mark E. Putnam, Dow's general manager. What synthetic methionine does: it puts more meat on poultry at less cost.

Dow may well preen itself on this process for synthesizing methionine from low-cost raw materials, for: (1) this amino acid will soon be used on a large scale in animal nutrition to supplement protein feeds low in it; (2) production of other low-cost synthetic amino acids can be expected; and (3) this development opens a new era in animal and human nutrition.

Soaring polythene production

U. S. output of polyethylene, which last year totaled only 12 million to 14 million pounds, has quadrupled this year. Annual production is now running at the rate of 50 million pounds. *—End*



Whichever way you look at it...

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With today's costs of manufacturing so high, it's the wise chemical buyer who considers his purchases from every angle. Price and specification alone are no longer basis enough for a buying decision.

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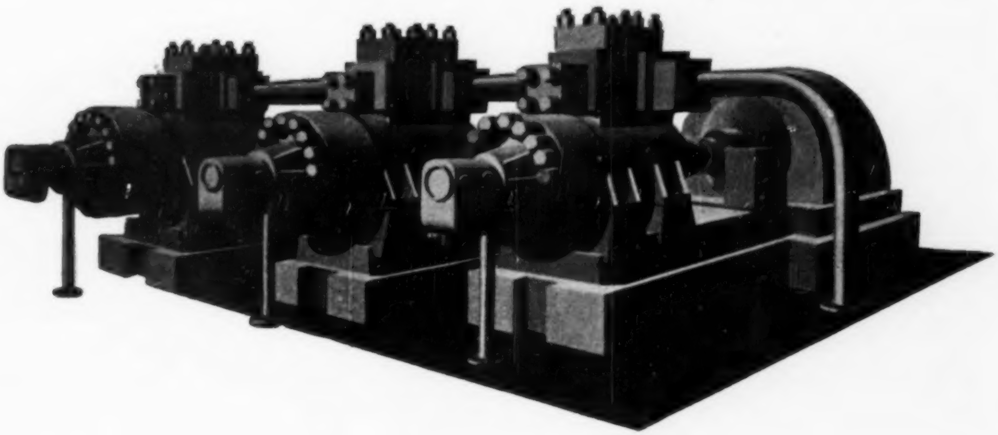

Largest pump capacity in terms of pressure and volume of any industrial centrifugal pump installation in the world is found in the power plant for the 18,000-ton forging press at Wyman-Gordon Products Corporation. Capacity is 1500 gal. per min. at 5300 lbs. per sq. in.—enough energy to pump the water contained in twelve tank cars in one hour from sea level to the top of Mount Whitney (altitude 14,510 ft.)

This unusual installation consists of three 8-stage units connected in series. Pressure increase through each pump is 1750 lbs. per sq. in. Each is driven by a 1,000 hp motor, and has an individual lubricating system which supplies Gulf Harmony Oil, noted for its successful performance under heavy loads, to the pump and motor bearings. Gulf Harmony Oil is rust and foam inhibited and has outstanding resistance to oxidation — helps insure long trouble-free pump and motor life.

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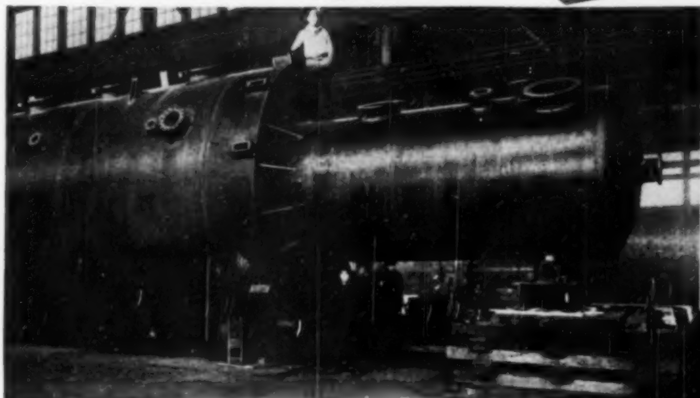

▲ A large atmospheric tower. Large section 13'-0" I. D.; small section 7'-0" I. D.; overall length 107'-4".

▲ A large fractionating tower. Large section, 13'-4" O. D.; small section, 10'-1" O. D.; overall length, 99'-1½".

▲ A group of air bottles, 16" O. D. x 54" long; made for 900 psi working pressure.

▲ Nickel-clad steel processing vessel for the manufacture of plasticizing materials.

The accompanying photographs illustrate the wide variety of fabricated work done by Combustion Engineering – Superheater.

Combustion offers you years of experience in this highly specialized field – experience in actually producing thousands of these vessels, simple and complex – large and small. This experience has frequently made it possible for our engineers to suggest minor changes in specifications which have effected substantial reductions in fabricating costs.

May we have the opportunity to quote on your next pressure vessel requirements?

B-335

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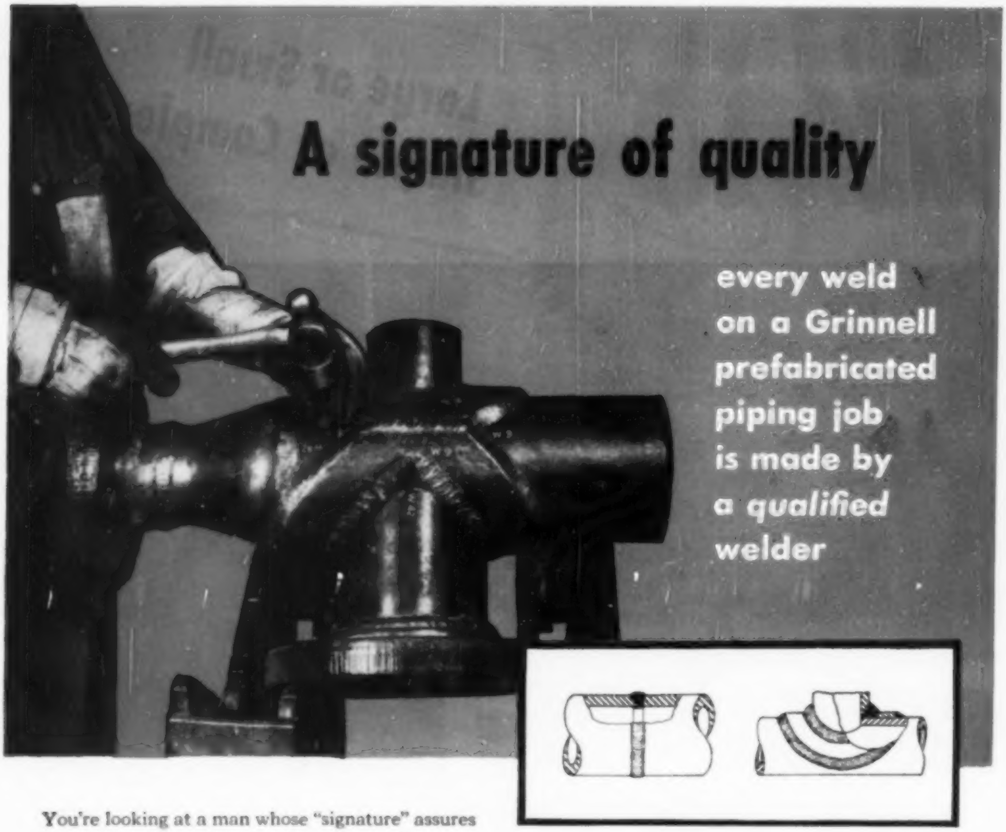
COMBUSTION ENGINEERING—SUPERHEATER, Inc.



You're looking at a man whose "signature" assures quality welding of piping. He's a Grinnell welder and, as every Grinnell welder, he is qualified by Grinnell according to a procedure which conforms to A.S.M.E. Boiler Construction Code, Section 9. After qualifying, he is given a number which he "signs" adjacent to each weld he makes.

Quality welding is only one of a long chain of responsibilities assumed by Grinnell on every prefabricated piping job . . . from the interpretive engineering to the on-time delivery of the fabricated piping. Such responsibility requires facilities for metallurgical research and testing, comprehensive knowledge of state laws and industry codes, and a complete familiarity with insurance company requirements for fabricated piping.

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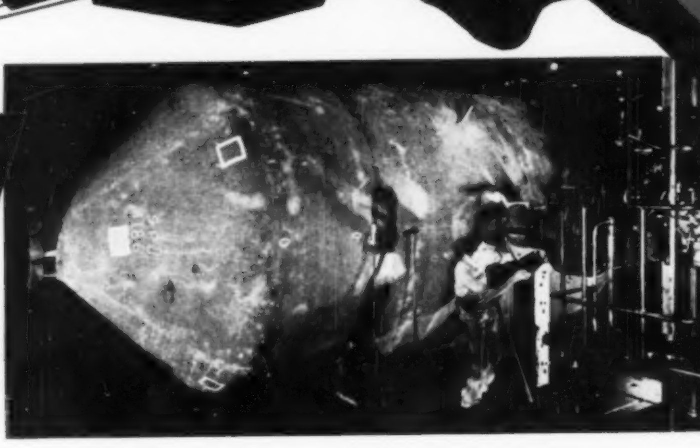
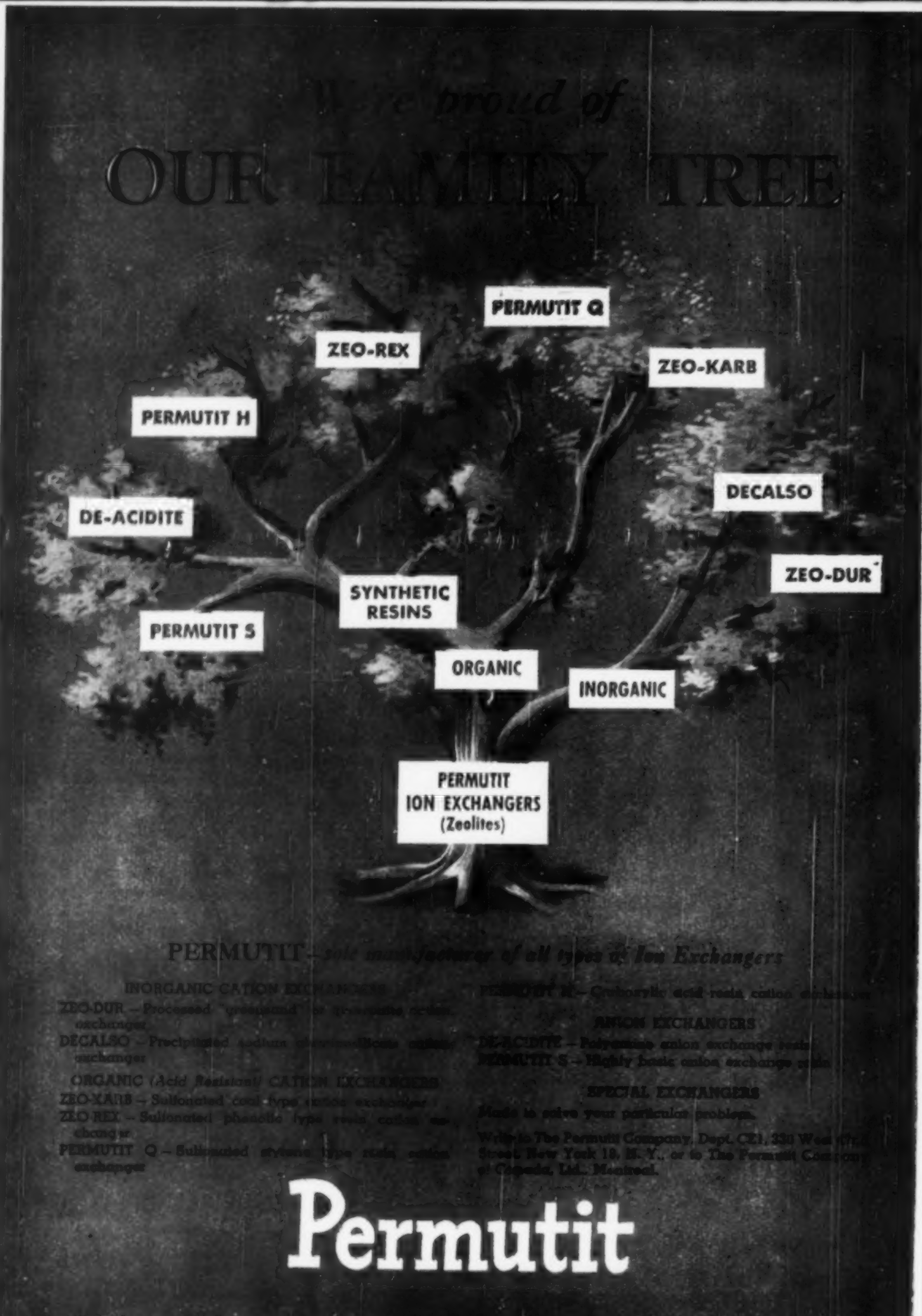


Finish-machining a trunnion on one of six 10-ft, 6-in. dia. rotating digesters for a northwestern mill, fabricated by B&W entirely from Croloy-Clad Plate.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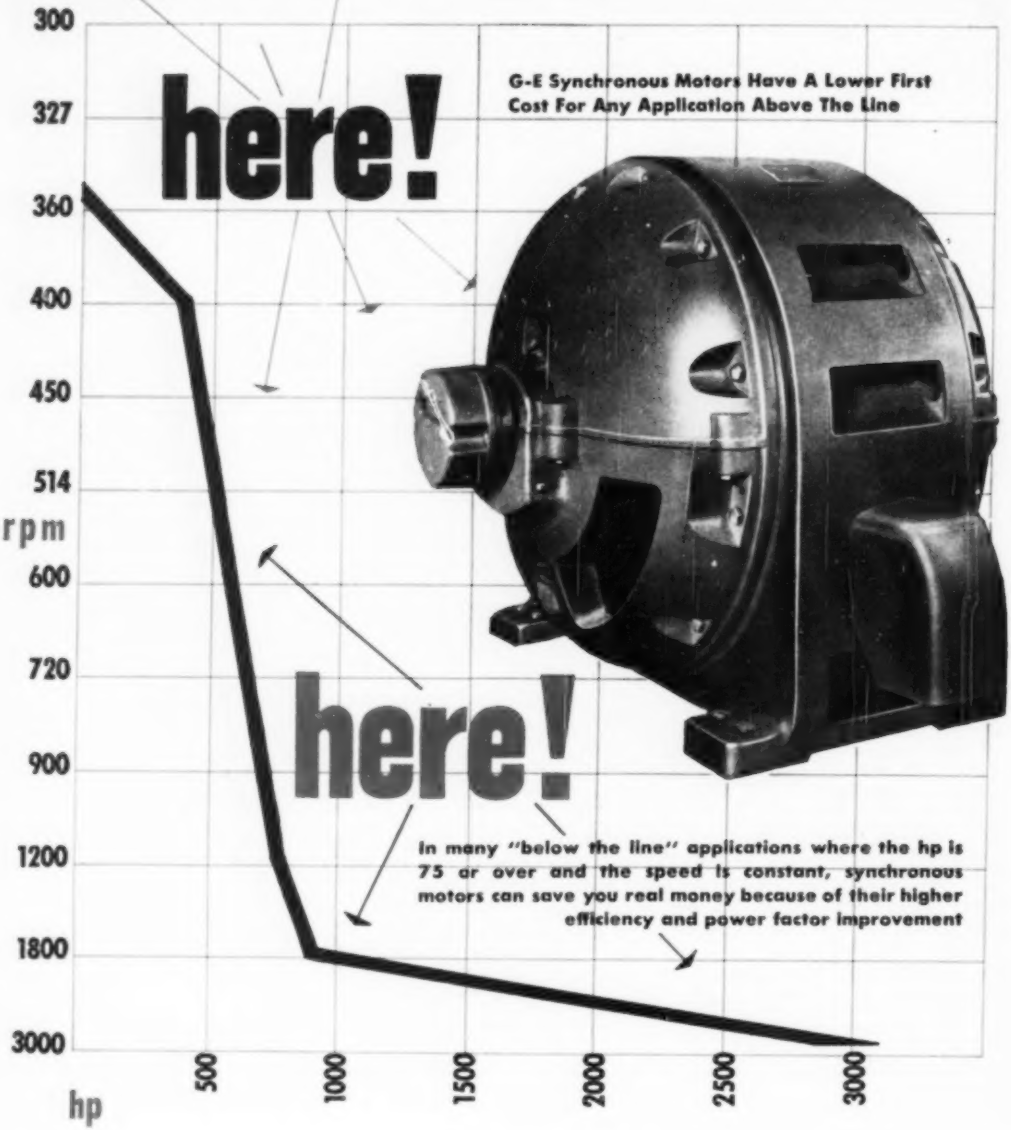
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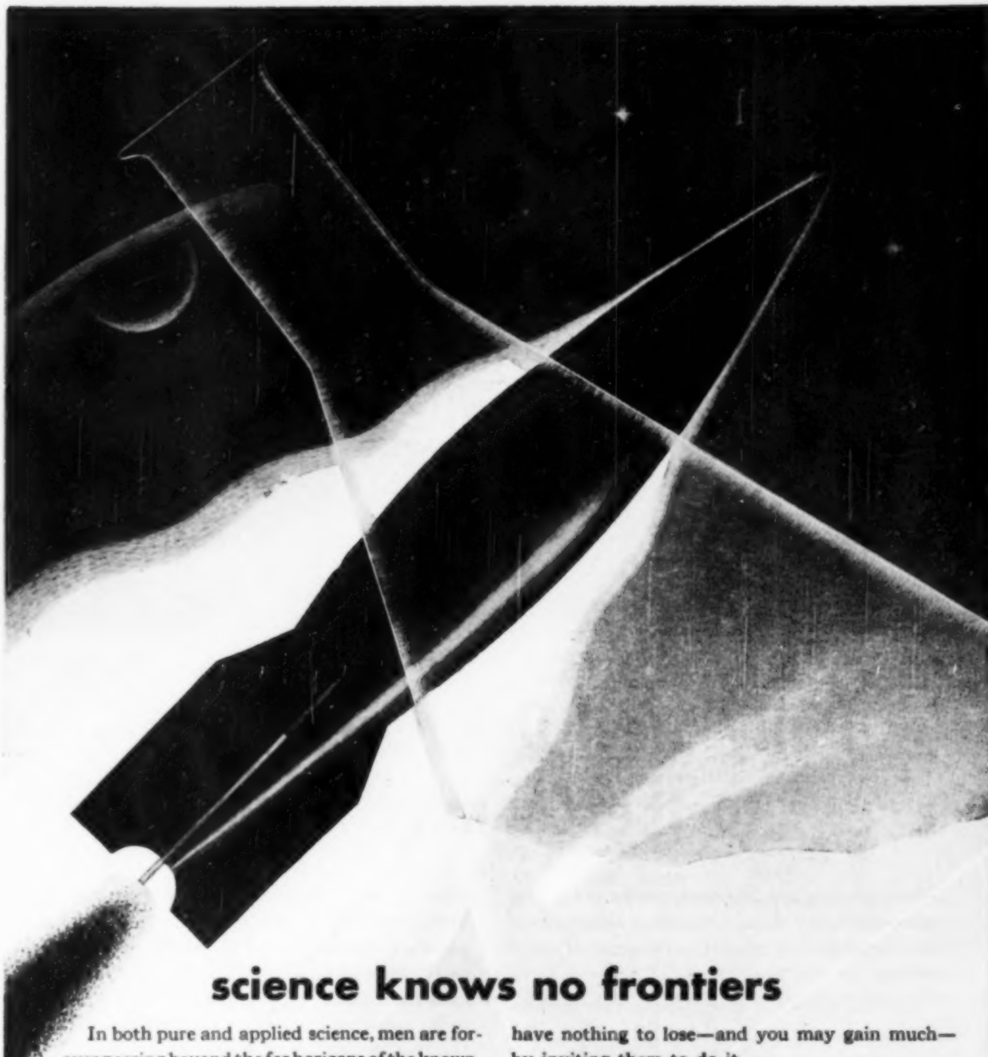

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Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

AUGUST 1949

Point Four *vs.* Private Enterprise

Six months have elapsed since President Truman announced his "bold, new plan" for developing the so-called "backward areas" of the world. During that time his proposal has been the subject of much discussion, some planning but, as yet, little or no action. Meanwhile, many engineers and industrialists are becoming impatient, if not frankly skeptical of the whole program.

Political commentators were prompt to point out that the President's plan was neither new nor bold. Henry Hazlitt of *Newsweek* traced the wording of the Truman statement back to Earl Browder's book on "Teheran" in which the former Communist had blueprinted a strange Soviet-American plan for world control. Edna Lonigan in *Human Events* reminded us that it was Henry Wallace who back in 1941 first proposed the "quart of milk for every Hottentot" scheme to the New School of Social Research. But Miss Lonigan was much more seriously concerned with the threatened invasion of government into an area that has been traditionally that of private enterprise. "If the American people permit a final consolidation of executive control through Point Four," she writes, "then political absolutism will darken the entire world for generations yet unborn."

We are not quite so apprehensive about the long-time political consequences, especially if the job can be done with private capital and a minimum of governmental control. But we should not lose sight of the fact that if our money and technical skills are invested abroad, we not only increase our competition in world markets but the American economy must be willing to accept payment on the debt in greatly increased imports of goods and materials. Thus Point Four becomes primarily a plan for promoting foreign trade. As such, it has recently been the subject of scholarly study and recommendations by the National Foreign Trade Council, Inc., in its published report "Private Enterprise and the Point IV Program."

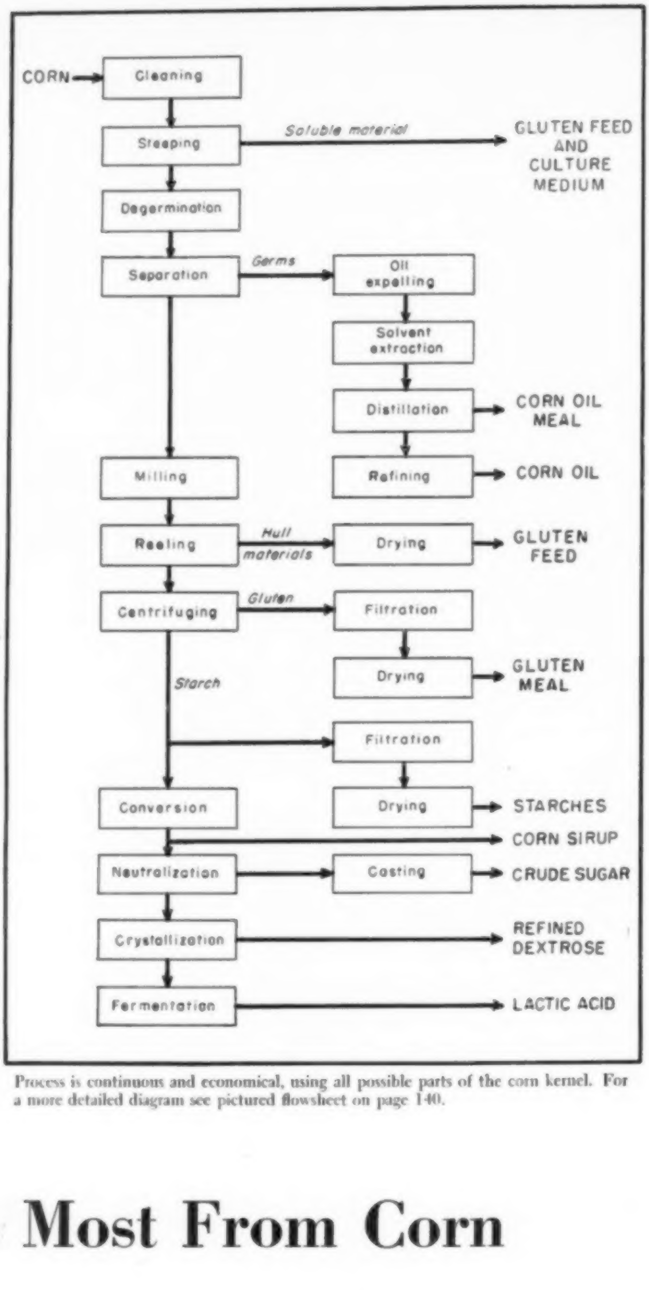
"Technical cooperation" on the part of the United States government should, in the opinion of NFTC, be limited to the sponsorship of missions in such broad fields as health, sanitation, agriculture and education. In other words, these should supplement and not supplant the function of competent private engineering firms or industrial consultants. "Industrial know-how is a commercial asset which has intrinsic value to private firms which possess it in the United States and other countries." It is "usually an integral part of the international movement of direct investment capital," hence "should be entrusted only to competent private firms."

The most important role of the governments involved should be to draft the rules of the game (through adequate commercial treaties) and see that they are properly enforced. Fair play on invested capital as regards non-discriminatory taxes and freedom from confiscation and expropriation, are prime considerations. But the Council holds that governmental "guarantees" are neither necessary nor desirable. Thus again we have the unexpressed fear that too much paternalism can lead only to regimentation and ultimate defeat for private enterprise.

The major role of American industry would be to increase production of goods and materials abroad through (1) provision of capital, (2) creation of new industries, and (3) modernization of existing processes of production and distribution. All this would be directed toward more effective use of natural resources, native manpower and, where appropriate, local funds supplied by the nationals of the participating countries.

This is the general direction in which we are moving. Point Four is both new and bold to the extent that it may clear the way for private enterprise to embark on a two-billion dollar program for exporting American capital and technology. But it can be an exceedingly hazardous and costly experiment if in the process we surrender to governmental domination and control.

One major raw material, shelled corn, yields a dozen products and half a dozen by-products. Nothing is wasted at Clinton Industries.



Process is continuous and economical, using all possible parts of the corn kernel. For a more detailed diagram see pictured flowsheet on page 140.

Making the Most From Corn

BYRON STARR

A typical example of a well integrated modern wet milling plant is the Clinton Industries' 42-acre layout at Clinton, Iowa. Here 48,000 bu. of shelled corn are processed into more than a dozen products including starches, corn sirup, crude and refined sugar (dextrose), corn oil, lactic acid and livestock feeds. No part of the kernel is wasted.

In addition to the corn, the other major raw materials are power and water. Boiler capacity of the plant is 600,000 lb. of steam per hr. at 400 psi. giving a generating capacity of 12,000 kw. Water requirements are approximately 15,000,000 gal. per day. Needless to say the establishment has its own water plant.

Corn arrives at the plant in box cars and is removed to a 700,000-bu. capacity corn tower by mechanical shovels. It is thoroughly cleaned by a system of screens and air separators before processing. Cleaned corn is conveyed to steeps (large wooden tanks) where it is soaked for two days in warm water containing a controlled amount of sulphur dioxide. The latter inhibits fermentation and softens the kernel preparatory to milling. Soluble materials from the steep are later recovered by concentrating the steep water which is drawn off before the corn goes to the milling operation.

STARCH RECOVERY

Separation and recovery of the starch is the prime objective of milling. Here is how that is done. Cleaned and softened kernels are first degerminated. Two studded steel plates, one rotating and one stationary, tear the kernels apart and extricate the germs without crushing them.

The disintegrated mass, germs and all, is next made into a slurry and poured into long wooden settling tanks. Because of their high oil content the germs rise to the top and are carried off in the overflow. The remainder of the kernel sinks to the bottom and is drawn off.

Finer grinding in Buhrstone mills is next on the itinerary of the degerminated corn. Ground pulp from this operation, consisting of hulls, gluten and starch, is pumped through a series of revolving reels and vibrating shakers. This unit consists of a wooden framework covered with nylon bolting cloth. Starch and gluten particles pass through this cloth while the coarser hull material is retained.

BYRON STARR *is corn technologist for Clinton Industries, Inc. at Clinton, Iowa.*

In the past only silk was used in these vibrating shakers. However with the increased availability of nylon the picture changed. Nylon proved longer lived than the silk and has now almost completely replaced it for this purpose.

At this stage three constituents have been removed from the corn kernel, soluble materials dissolved in the steep water, the germ, and the hull. A thin slurry of starch and gluten remains. There are two methods of separating these two. First is the old method. The mixture is pumped onto long gradually inclined wooden "starch" tables. As the slurry flows down the table the heavier starch granules settle out on the table while the lighter gluten particles are carried off the end of the table with water. Separation completed, the settled starch is flushed from the table with more water.

A more recent method has been developed which is eventually expected to replace the old "starch" table. It consists of merely passing the material through centrifugal separators which make a clean cut separation of the starch and gluten. Rotors in these machines are made of Type 316 stainless steel. The housings are bronze.

The starch slurry is not altogether pure yet. Last traces of soluble materials are washed from it in a series of continuous vacuum filters. Tanks for these filters are made of Type 316 stainless steel cladding. The spokes are of Type 316 stainless steel or "Everdur" and the decks are wooden. Washed starch cake is removed from the drums either by a "doctor-blade" or string discharge arrangement.

One more step . . . the starch is reslurried. Now it is ready for further processing into a finished dry starch product or some other product into which it can be converted. One of these products is corn sirup.

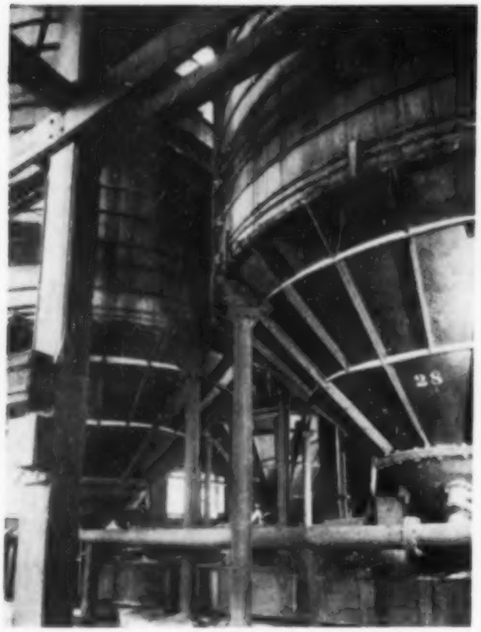
CORN SIRUP

Starch is converted into corn sirup in 2,700-gal. capacity bronze pressure vessels, called converters. It is drawn into the converter in a slurry along with a controlled amount of hydrochloric acid. The batch is cooked by direct injection of steam to a pressure of 30 to 40 psi. until the desired degree of hydrolysis has been reached. The hydrochloric acid acts as a catalyst to break down the starch molecules into dextrins and sugars, principally dextrose and maltose. After proper conversion the liquor is removed to a wooden neutralizer tank where sodium carbonate is added to neutralize the acid. Here some of the impurities which are inherent in native starch coagulate, rise to the top, and are removed by skimming; the rest are removed by mechanical filtration. The sirup liquor is then partially concentrated in a triple-effect vacuum evaporator. At this stage the liquor is decolorized with activated carbon. The carbon is removed by filtration and the clarified liquor is concentrated to the desired Baume in a single effect vacuum evaporator. Finished sirup is discharged into large steel tanks where it is immediately cooled to prevent discoloration. From these tanks the sirup is loaded for shipment. Most of it leaves the plant in 8,000 gal. tank cars. It is also packed in 50-55 gal. barrels or drums, and 5 and 10 gal. cans.

Since the war, equipment has been installed for the production of a new product, dried corn sirup. The mechanism for the drying is contained in a large cast iron housing. Finished corn sirup is brought into the evacuated chamber and fed between two steam heated chromium plated, rolls. The thick viscous sirup is dried down to less than 5 percent moisture. In this form it is a dry white solid. The dried sirup is scraped off the heated drum rolls and is either packed in granulated form or ground in a mill and reduced to a powder.

CORN SUGAR

The manufacture of corn sugars parallels that of corn sirups. The difference lies in the degree to which the original starch slurry is converted. In the sugar conversion the objective is to obtain as complete a yield of dextrose as possible from the starch. The refining process for such liquor is nearly the same as that for sirup liquor. Refined sugar liquors are pumped into crystallizers with stainless steel clad interiors. Here they are crystallized in motion over a period of approximately four days during which time the temperature is reduced on a carefully predetermined schedule from about 115 to about 70 deg. F. Refined sugar crystallizes into small crystals of pure dextrose suspended in a mother liquor known as corn sugar molasses or hydrol. The "magma" is drawn from the crystallizers into basket centrifugals. The baskets of these centrifugals are fabricated from stainless steel or bronze covered with stainless steel, monel or bronze screens. Perforations in the basket permit the hydrol to pass through but retain the crystals. Before leaving the centrifugal the sugar is washed free of hydrol by playing a fine spray of water on the cake. The washed caked is then plowed from the basket and dried in rotary dryers with stainless steel clad interiors. Dried sugar is pulverized, screened, and pack-



WOODEN STEEP TANKS where corn is soaked for two days to remove solubles and soften kernels for milling.

STAINLESS STEEL CENTRIFUGES for separation of starch and gluten have replaced older "starch" tables.

ed in 100-lb. bags for shipment. The hydrol, obtained as a byproduct, is sold as a livestock feed.

Crude sugar is produced by casting partially refined sugar liquors in molds. It sets up into solid blocks of sugar containing the mother liquor and non-sugar components. It is either distributed in the block form or chipped and packed in 100-lb. bags.

LACTIC ACID

Lactic acid is produced from the fermentation of dextrose by lactobacilli. Wooden fermenters are charged with dextrose, a nutrient powdered limestone ($CaCO_3$) and then inoculated with a lactobacillus culture. The function of the $CaCO_3$ is to convert newly formed acetic acid into calcium lactate. If the concentration of lactic acid were allowed to build up the bacteria would destroy themselves before the reaction reached completion. The fermenter liquor is transferred to the acidulator where sulphuric acid is added. This regenerates the lactic acid and precipitates calcium sulphate which is subsequently removed by filtration. The dilute acid is concentrated to the desired strength and is decolorized with vegetable carbon.

Since lactic acid attacks most of the ordinary construction materials, corrosion problems are encountered. Special materials are used for the heat exchangers and the vacuum evaporators are either rubber or glass lined. The acid is finished to its final concentration in a glass lined pot still. Ceramic valves and piping, and Type 316 stainless steel troughs and sheathing are used for handling and transferring the acid. The finished acid is shipped to the consumers in resin lined or wooden tank cars, paraffin lined barrels, and carboys.

DRY STARCHES

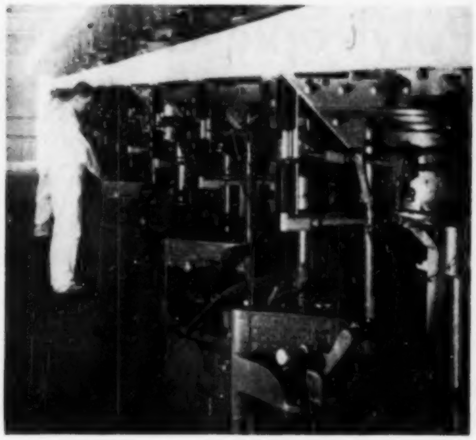
Starch is pumped to the starch plant in a water suspension. For most dry starch products the starch is immediately removed from suspension with a vacuum string-discharge filter. Cake from the filter is broken up into appropriate sized pieces which fall onto an endless belt of perforated stainless steel, leading through a continuous tunnel dryer. The starch enters the dryer at approximately 44 percent moisture, travels countercurrent to a circulating draft of warm air and emerges at 10 to 14 percent moisture. Starch in this form is sold as pearl starch. Some of the pearl starch is ground and screened into powdered starch.

Lump or gloss starch is made from powdered starch containing a slightly higher percentage of moisture than the regular grade. The starch is put into a cooker where it receives a special heat treatment and is then run into steel cylinders and pressed in a hydraulic press. The starch granules adhere to each other and remain in a lump form. The large lumps are removed from the cylinders, and are crushed to the desired size for packaging.

DEXTRIN PRODUCTION

Dextrins are made by roasting common starch with or without the addition of small quantities of chemical reagents. The roasting procedure thins out the starch very markedly and gives it a tacky characteristic, rendering it particularly adaptable for adhesives. A wide variety of dextrins is available differing in the degree of conversion which affects the water solubility, the tackiness, the viscosity of the solution, and the general adhesive properties of the product. Some dextrins are blended with other materials to give them the particular adhesive charac-

CAST IRON DRYER used to make dried corn sirup, reduces liquid sirup to less than 5 percent moisture content.



BRONZE BASKET CENTRIFUGES spin dextrose crystals from the crystallized mother liquor magma.

Proper use of materials of construction plays a large part in the successful manufacture of products from corn. Here are just a few of those found at Clinton.

teristics required for special application.

To manufacture oxidized or acid modified thin boiling starches the starch slurry, pumped from the milling division, is treated with the proper chemicals in wooden tanks. Sodium hypochlorite is used for preparation of oxidized starches, and hydrochloric acid, for acid modified starches. After the chemical treatment has produced the required thinning, the starch is removed from the slurry with a string discharge vacuum filter and dried in a tunnel dryer.

CORN OIL

Approximately 1¾-lb. of oil is recovered from each bushel of corn processed. This comes from the germs which were separated during the milling process. Dried in a rotary steam tube dryer they are put through expellers which squeeze out most of the oil. This operation reduces the oil content from approximately 50 to 15 percent. To obtain more of the oil, cake from the expellers is flaked and solvent extracted counter currently with hexane. After recovery of the oil, solvent is removed by distillation and the flakes, retaining less than 1 percent oil content become corn oil meal livestock feed.

Oil obtained both by expelling and by solvent extraction are combined and filtered to remove suspended solid material from the crude corn oil. Treatment with a strong alkali and high-speed centrifugal separators remove the free fatty acids and other impurities. This is followed by washing with water and drying under a vacuum. The oil is then bleached with clay or activated carbon. Volatile impurities are carried off by steam distillation under high vacuum, resulting in a bland product. The final refining step is dewaxing. This is done by chilling the oil to winter temperatures and filtering out waxes which solidify during the chilling process.

Refined oil is packaged in pint bottles, 1-gal. and 5-gal. cans. Shipments are made to large consumers in 55-gal. drums or tank cars. The byproduct, a soap stock, is sold to soap manufacturers.

COMMERCIAL FEEDSTUFFS

Most of the non-starch constituents of the kernel, with the exception of the germ, are sold of commercial feedstuffs. Steep water which removes about 3-lb. of soluble material from each bushel of corn is concentrated in vacuum falling film evaporators to about 54 percent dry substance. Concentrated steep water has played a very vital role in the production of penicillin and streptomycin. It is used as the nutrient for growing the organisms which produce these antibiotics. Steep water not sold for this purpose is mixed with other materials to produce corn gluten feed. The other components of this feed are the hulls and grits which have been de-watered in screw presses and more completely dried in flash dryers. Final drying with all these materials mixed together is done in rotary dryers. Corn gluten feed has a protein content of 23 percent and is widely used as a dairy feed.

CORN GLUTEN MEAL

The gluten is partially de-watered by settling in Dorr thickeners and by centrifugation, and further de-watered by filter pressing to a wet cake. The cake is removed from the presses and dried in rotary steam tube dryers. This material is the principal constituent of corn gluten meal (41 percent protein) or may be used to enrich corn gluten feed.

Polytropic Compression in Centrifugal Compressors

Confusion has arisen concerning the exact meaning of polytropic efficiency among some readers of the author's recent series of articles on centrifugal compressors. This article clarifies the point

IGOR J. KARASSIK

In a recent series of articles (I. J. Karassik, Process Engineer's Guide to the Centrifugal Compressor, *Chem. Eng.*, Oct., Nov., Dec. 1947, Jan., Feb. 1948) the author presented a conception of the centrifugal compressor from the point of view of theory and design practice. The articles introduced certain technical data necessary in the computation of centrifugal compressor application problems. In the description of the polytropic compression which takes place in a centrifugal compressor a formula was presented giving the relation between the fluid (or real polytropic) efficiency e_p, the polytropic exponent n, and the exponent $k = c_p/c_v$. The polytropic efficiency e_p is:

$$e_p = \left(\frac{n}{n-1}\right)\left(\frac{k-1}{k}\right) \qquad (1)$$

or, in the more usual form:

$$\frac{n}{n-1} = \left(\frac{k}{k-1}\right)e_p \qquad (1a)$$

This relation was derived with the assumption that no energy is added to or subtracted from the compressor beyond the work transmitted to it at the shaft. Therefore, the equation is valid only for an uncooled compressor, with the assumption that radiation and bearing losses are negligible.

To those engineers who are mathematically inclined and who are familiar with its derivation, the meaning of the formula presents no particular problems. However, the relation has frequently puzzled engineers unaccustomed to dealing with centrifugal compressors. The present article therefore aims to dispel some of the misunderstandings which arise in interpreting the relation.

IGOR J. KARASSIK *is an application engineer with Worthington Pump and Machinery Corp., Harrison, N. J., specializing on centrifugal pumps and compressors.*

A few of the definitions of the terms involved in the discussion which follows are presented here to make the present discussion self-contained:

Ratio of Specific Heats—The factor or exponent k is the ratio between the specific heat of a gas at constant pressure, and its specific heat at constant volume, or $k = c_p/c_v$.

Adiabatic compression occurs when no heat is added to or removed from the gas during compression. The characteristic equation for adiabatic compression is pv^k = Constant.

Isothermal compression occurs when heat of compression is removed during compression, so that the temperature of the gas remains constant. The characteristic equation for isothermal compression is pv = Constant.

Polytropic compression is characterized by the equation pv^n = Constant.

If reference is made to Fig. 1, which shows gas compression on the usual pressure-volume diagram, it will be seen that the slope of the compression curve is a function of the value of the exponent n. For certain specific values of n, the compression is given other definitions. For example, when $n = 1$, the compression is isothermal; when $n = k$, it is adiabatic.

Generally, centrifugal compressors are not cooled and compression would be adiabatic only if it were to take place with 100 percent efficiency. However, the inefficiency of the compressor results in the addition of heat during compression. As a result, the actual compression in an uncooled centrifugal compressor is assumed to

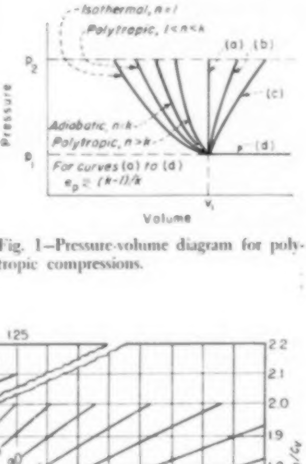


Fig. 1—Pressure-volume diagram for polytropic compressions.

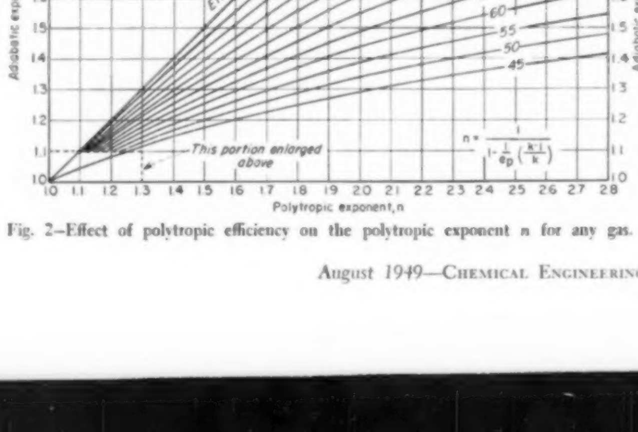


Fig. 2—Effect of polytropic efficiency on the polytropic exponent n for any gas.

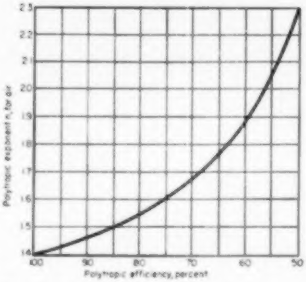


Fig. 3—Effect of polytropic efficiency on the polytropic exponent n for air.

be polytropic with a constant value of n greater than k.

The relation described by Eq. (1) is shown graphically for any value of k in Fig. 2, while Fig. 3 shows a graphical solution of the relation for air when $k = 1.3947$.

The two sources of confusion in interpreting Eq. (1) are:

1. Incorrect comparison to the phenomena in a reciprocating compressor.
2. Apparent uncertainty of the meaning of the equation for certain low values of polytropic efficiency e_p.

As to the first, engineers accustomed to dealing with reciprocating compressors recall that the compression in such machines is somewhere between adiabatic and isothermal, owing to the fact that such compressors have cooling jackets which remove the heat resulting from inefficiency, as well as some of the heat of compression. Consequently, the polytropic exponent n is lower than the exponent k. If, then, reference is made to Figs. 2 and 3, the only way in which the exponent n could be lower than k would be for the polytropic efficiency to exceed 100 percent—which is impossible. This comparison with reciprocating compressors is, of course, incorrect since they are water cooled. Eq. (1) therefore does not apply, because it was derived strictly on the assumption that no energy is added or removed beyond the work applied to the compressor at the shaft. The use of water jackets on reciprocating compressors violates this assumption and therefore voids the applicability of Eq. (1).

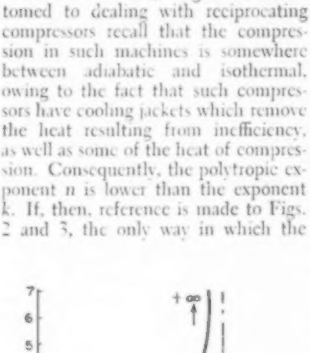


Fig. 5—Effect of polytropic efficiency on the polytropic exponent n for air over entire range of efficiencies.

The inconsistency of comparing reciprocating and centrifugal compressors can best be explained by an analogy. Let us assume a centrifugal pump driven by an electric motor. Let us further provide a small brake and a water turbine connected to the outboard end of the pump, as in Fig. 4. If the pump develops 70 water hp., if the pump efficiency is 70 percent, if the brake absorbs 5 hp. and the turbine is inactive, the electric motor will have to supply 105 b.hp. of which only 100 is absorbed by the pump (Case I).

Here, the apparent efficiency of the pump and brake combination is 70/105 or 66.7 percent, even though the pump efficiency is 70 percent. This arrangement can be compared to an uncooled centrifugal compressor on the basis that the 70 water hp. corresponds to the adiabatic horsepower, while the 105 b.hp., supplied by the motor corresponds to the brake horsepower of the centrifugal compressor. The increase in power consumption caused by the brake corresponds to the compressor losses which result from heating of the gas handled on account of compressor inefficiency. The lower the efficiency of our pump, the greater will be the size of the brake with which we will saddle it, and the lower the apparent over-all efficiency of the pump and brake combination. In the same manner, the lower the polytropic (or fluid) efficiency of a centrifugal compressor, the greater will be the increase in the exponent n over k (see Figs. 2 and 3), the greater the increase in fluid head over adiabatic head, and the increase in power consumption due to compressor inefficiency.

If we now use the small water turbine in tandem with our motor, pump and brake combination as in Case II, Fig. 4, we can reduce the power supplied by the motor. If further we do not penalize our accounting by the energy consumed by the water turbine, the apparent efficiency of the pump, brake and water turbine combination will be increased appreciably. Thus, for instance, in Case II, the water turbine supplies 5 b.hp. and so exactly compensates for the power consumption of the brake. The motor supplies 100 b.hp. and the new apparent efficiency of the combination is 70 percent. This would be the case with our centrifugal compressor in the event we supplied water cooling to the machine in such proportions as exactly to compensate for the heat developed in excess of the heat of adiabatic compression. The real fluid efficiency would still be 70 percent, but because our compression would be strictly adiabatic, the adiabatic efficiency would be equal to the fluid efficiency.

If we increase the size of the water turbine to 35 b.hp., as in Case III, Fig. 4, the motor supplies only 70 b.hp. and the apparent efficiency of the combination has become 100 percent. Finally, by increasing the size of the water turbine still further, to 45 b.hp. (Case IV), the motor supplies but 60 b.hp. Since the pump still develops 70 water hp. and since we are not penalizing the combination by the water turbine energy, the apparent efficiency is 70/60 or 116.7 percent. This last arrangement would be comparable to a cooled reciprocating compressor wherein we remove both the heat of inefficiency and some of the heat of compression. The compression is between adiabatic and isothermal and the exponent n is lower than k.

In the case of uncooled centrifugal compressors, where Eq. (1) is used, there is no water turbine to supply some of the power and there is always a brake which absorbs the difference in power above that which would be re-

(*Continued on page 131*)

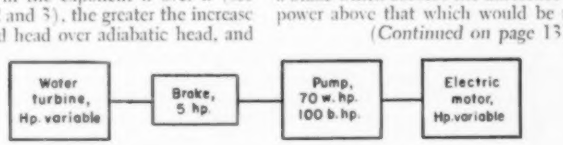
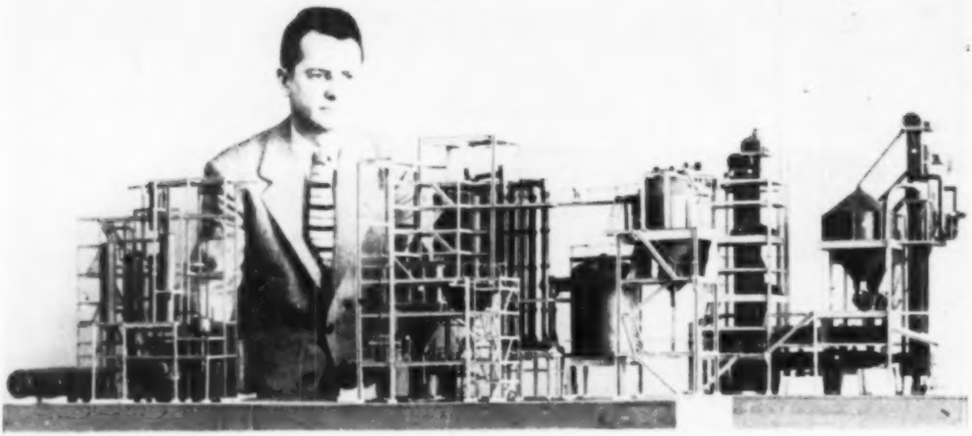


Fig. 4—Analogies to compressors—Case I: to uncooled centrifugal compressor; Cases 2, 3 and 4: to water-cooled reciprocating compressors*

	Hp. Produced: Turbine	Hp. Produced: Motor	Pump Effy.	Apparent Effy. of Pump-Brake-Turbine Combination
Case I	0	105	70%	66.7%
Case II	5	100	70	70
Case III	35	70	70	100
Case IV	45	60	70	116.7

* Eq. (1) does not apply to water-cooled reciprocating compressors.



KOPPERS COAL GASIFICATION PLANT. MODEL COST $1,600.

. . . models help train operators; they can trace pipelines, locate their valves, see the relationship of all the equipment.

Why Make A Model?

Your model will save money if you use it right. Show it to everyone. Your designers will see waste space. The safety man will catch head-bumpers. Operators will spot valves they can't reach.

H. J. BOWEN

ALTHOUGH scale models have been used extensively by architects and ship builders, they are still looked upon by many engineers as expensive toys. Only one of fifty major chemical and oil companies recently interviewed uses them consistently for engineering purposes. Why? Because models of chemical plants and refineries have usually been very expensive and have not been fully utilized. Many were built by the user in his own shop, or by a hobbyist. Models were often built too late to be used in design and construction of the plant.

Recently justification for models has improved. They are now being built for less and used for more. Studies in safety, plant layout, flow of materials, labor economy, maintenance, and plant expansion, are made from models of existing plants.

As a device for communicating ideas and pictures, models have the advantage of an extra dimension over drawings. In attempting to depict three dimensional objects, drawings often sacrifice clarity and fail to convey the complete picture to many people. So many drawings are required for illustration of complex objects that hours of study may be needed before even the experienced draftsman can visualize them. He first translates three dimensional images into two dimensions and then all who use his blueprints must translate them back again. This double translation consumes much time and introduces a double opportunity for error.

Justification for models stems from their ability to make up for these shortcomings in drawings. They are no substitute for prints (exceptions to be noted), but are a much needed supplement.

USEFUL IN DESIGN

Design work often drags due to inability of one group to sell its ideas to other groups. All the physical variables affecting optimum equipment arrangement are apparent in models, but usually are not in prints. Thus the model acts as a catalyst, speeding up the exchange of ideas.

The model may start at any design stage after the major vessels and pieces of equipment are sized. These are moved around to experiment with plant equipment layouts. When the desired arrangement is established, the supporting structures and buildings can be designed. A modelmaker then duplicates the plant in miniature, using real structural members. When this is completed, the designer can use it to develop piping drawings.

Complex piping drawings may cost $2,000 to $3,000 each due to the large amount of study time needed to ascertain the best piping runs. Models, of course, can reduce this study time, particularly in multi-story structures.

The shortage of experienced piping designers in recent years has been a factor in delaying plant start-ups. Because it gives them a power of visualization which was previously lacking, models allow less experienced men to do this type of work. Piping can be added to the model as design proceeds or after piping drawings are completed.

Models provide an excellent check on the finished design. They quickly

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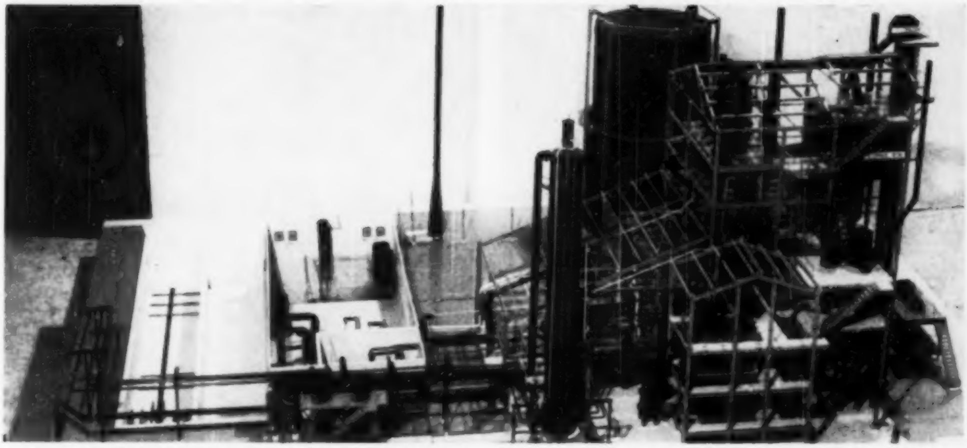
H. J. BOWEN *is the young chemical engineer (Yale '41) in the picture above. He is also a former Du Pont design engineer and the organizer of his own three-year-old, seven-man company — Industrial Models, Wilmington, Del.*



DU PONT CHEMICAL PLANT. MODEL COST $2,500.

. . . models catch design boners like pipelines that run into beams, and doorways too narrow to get equipment through.

reveal design errors and omissions, safety hazards, waste space, crowded areas, improper lighting arrangements, inaccessible valves and equipment, missing safety showers and escape ladders, and whether allowance has been made for future expansion. Interferences such as pipes running into beams or vessels that won't go into buildings are naturally caught in models. They are almost bound to produce better design quality if the design is at all complex. This constitutes building insurance and adds up to faster design at less cost.

USEFUL IN CONSTRUCTION

The chronology of installation is often difficult to analyze from blueprints. It is not uncommon to see prematurely installed steel beams removed to permit the installation of a large vessel. In such cases idle crews push costs up and retard completion dates. When plants begin to take shape and can be visualized, all sorts of omissions are often discovered. Construction is turned upside down in the rush to get them in before the start-up deadline. All these difficulties can be spotted ahead of time with models.

The man responsible for starting up a new and complex operation is faced with formidable problems, some of which can be greatly simplified by models. They facilitate preparation of the job breakdown. Since the job breakdown is the basis for training operators and establishing labor requirements and standards, it is important that it be accurate. An error in estimating labor requirements may result in overhiring or underhiring.

In some respects models are superior to the real plant as a labor training device. The operator can see the relationship of all the equipment and trace a pipeline through the plant very much faster than by walking through the real plant. Shift supervisors sometimes color code the pipe in a model as a training scheme. They can thus quickly become familiar with all piping and valves in their area. If additional valves or pipes are needed, they are almost bound to be discovered before the start-up.

Part of the training of foremen and operators is correlating in their minds process and equipment information. Another step in their education is the indoctrination of safety principles. In both phases of the training program, models save time by obviating the tedious mental processes entailed in visualizing unfamiliar and complex objects.

One model, made specifically for safety education, depicted a ficticious factory in which workers were committing various unsafe practices. This was exhibited in numerous plants and succeeded in drawing the attention of workers to the dangers.

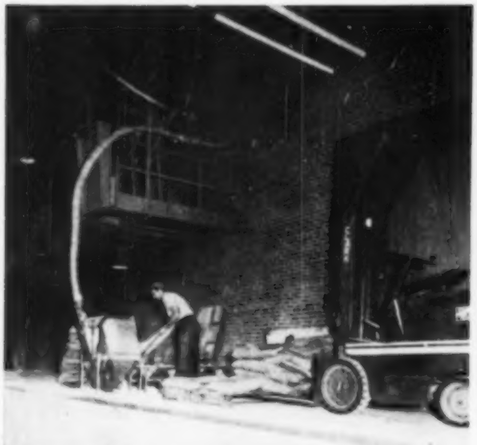
Men engaged in plant layout, process improvement, and labor studies can use models to advantage. These men normally spend appreciable time away from their desks studying physical layout of equipment. They would save a lot of this time and legwork if they had a model. Models are also used to find usable floor space as an alternative to enlarging buildings at high present day construction costs. A model was made for one large company which had 200,000 sq. ft. but needed more. At present day construction costs, they needed to find only 180 sq. ft. of usable space to justify the model.

If a model merely pays for itself, it is a failure. It should do much better than that. Savings credited to a model will usually vary with the number of groups who use it and with the complexity of the object it depicts. Sometimes the cost is shared by two or more groups. It is not possible to predict in advance what total savings can be expected.

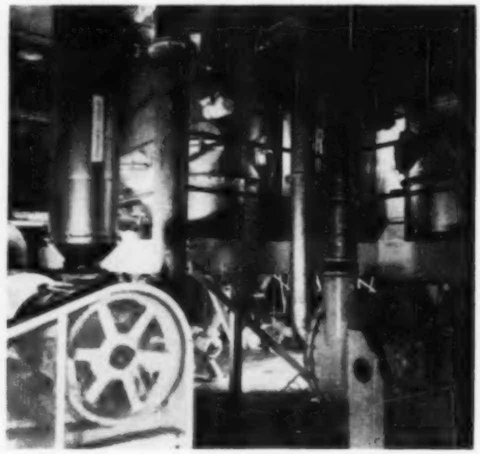
Experience indicates that a model of a new and complex process, if fully utilized for design, construction, and plant start-up, will be a very profitable investment. In the case of an average chemical plant or refinery, the model can usually be justified even if used only for the start-up.

There is less need for modeling standard plants because presumably the designers, construction forces and operating men have had experience with the prototype. It may be, however, that a large number of the operating and construction men have never seen the prototype, or that design improvements have been made. In this case models may be worthwhile.

Models should not be used where templates or drawings will convey the picture to non-technical personnel. Justification for modeling existing plants should be carefully examined, since it will be submarginal in many cases. The model should have specific objectives: for example, to train labor, plan repairs, or visualize expansions.

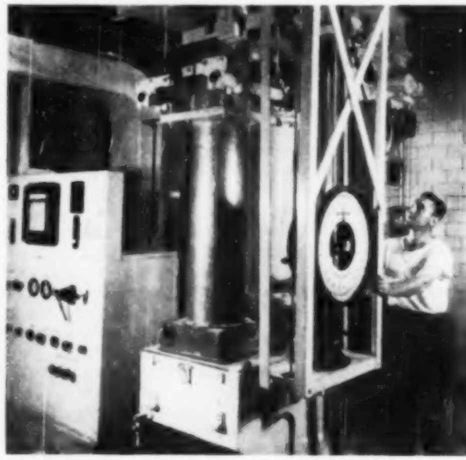


1. UNLOADING of resins, whether received in bags or bulk, is done pneumatically. It's easy, fast and keeps resins clean.



2. COLLECTING and sifting airborne resin from receiving platform. For dustlessness, sifter is in tank (behind blowers).

5. PROPORTIONING pigments. Hood keeps dirt out of pigments, pigments out of operator. He never has to go inside.



6. CHARGING resins to Banbury. Operator has jockeyed cylindrical weigh hopper along overhead tracks from storage.

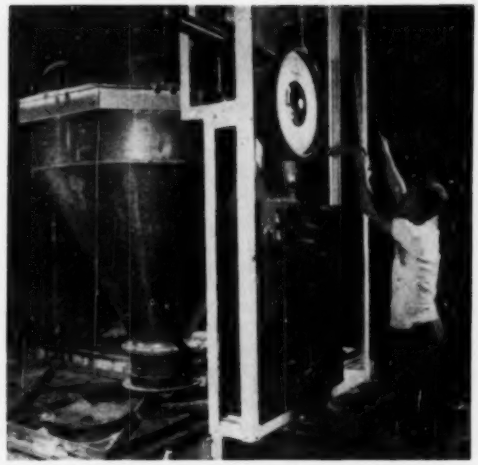
Materials Handling in Plastics Processing

Bakelite's newest vinyl compounding plant is a study in movement of materials. They've gone all out to do it efficiently. Prime requisites: prevent product contamination: promote workers' safety.

Materials handling, designed primarily to insure (1) safety to personnel, (2) cleanliness and freedom from contamination, and (3) ease of operation, is one of the most important aspects of the new vinyl plastics compounding plant of Bakelite Corp. at Ottawa, Ill. Three years ago (August 1946) this magazine described Bakelite's new Bound Brook, N. J., vinyl plastics fabrication plant, which

JAMES A. LEE *is the* Chemical Engineering *Editorial Representative located in Houston, Tex.*

3. STORING resins in 30-ton bins. Resins are brought here from collecting station (photo 2) by pneumatic conveyor.



4. WEIGHING resins and bringing them from storage bins is job of this weight lorry. Hopper and scale ride overhead.

7. PACKAGING finished vinyl sheets. Note elaborate use of ball and roller conveyors to save operators' backs and speed work.

8. SHIPPING finished products. Many fork trucks are used in huge products warehouse and here on shipping platform.

was then the last word in plastics compounding. The Ottawa plant incorporates numerous new ideas resulting from experience gained in the New Jersey plant and embodies many features which insure making the highest quality products possible.

Briefly, the plant produces two classes of vinyl materials: rigid and non-rigid. They are both calendered products, but vary in characteristics, composition, and properties, as well as in dimensions. The rigid compounds are produced as continuous sheet, 54 in. wide and in thickness ranging from 0.005 to 0.008 in. They are also supplied as cut sheets, 51¾ x 21¾ in., in thicknesses of 0.005 to 0.015 in. These compounds are made from mixtures of solvent type resins formed by the copolymerization of vinyl chloride and vinyl acetate. The vinyl chloride content ranges from 85 to 91½ percent. Stabilizers, lubricants and colorants are added to this mixture.

The non-rigid, or flexible type, is produced as a continuous film up to 73 in. wide and down to 0.004 in. thick. Such film is compounded from resin, plasticizer, stabilizer and colorants. The resin is a non-solvent type vinyl chloride-acetate copolymer containing between 94½ to 96 percent vinyl chloride. The plasticizer content of the compound ranges from 30 to 40 percent.

In addition to the Vinylite resins which are the most important raw materials, other materials include plasticizers, heat stabilizers, lubricants, and finally a variety of colorant materials and light stabilizers.

The first operations consist in gathering the various raw materials in extremely accurate quantities and then mixing these batches intimately to assure uniformity in the final products.

Both rigid and non-rigid types of vinyl plastics are sheeted continuously

on a calender, cooled, wound into rolls, or cut into sheets of standard size. Rigid sheets are then given the desired surface finishing by placing in a heated planishing press. All products receive a final inspection, test sampling, and packing. They are then transferred to storage, pending shipment.

MATERIALS HANDLING

Bearing in mind the necessity for safety, complete avoidance of contamination, and for a high order of plant housekeeping, the methods chosen for materials handling are the most effective obtainable from an operating standpoint, with gravity doing as much work as possible. Incoming resins are handled pneumatically and delivered to storage bins. Liquids handled on a large scale are pumped to storage tanks. Other smaller quantity raw materials in bags or drums are handled into and out of storage by electric fork trucks. For batching, the larger quantity materials are assembled in weigh hoppers. These are of the weigh lorry or travelling type for solids and stationary for liquids. The smaller scale batching is also facilitated at various points by a variety of mechanical handling devices. Electric hoists, ball, and roller conveyors are used in final inspection and packing; fork trucks in product storing and shipping.

PLANT LAYOUT

Physical arrangement of the plant is also designed to simplify both processing and materials handling. There is one large building and a power plant. All processing takes place in the main building. It also houses all storage except for outdoor tanks for plasticizers and lubricants. Railroad sidings are adjacent to both the power plant coal storage silo and the main building. The latter includes a covered track and platform for loading and unloading operations regardless of weather conditions, as well as two covered truck docks for receipt and shipment by truck. Whereas the bulk of raw materials receipts is by rail, most finished product shipment is by truck.

About two-thirds of the ground area of the main building is single-story, with the remaining third capped by a three story section which is in turn capped with a tower for the 20 resin storage bins. To make full use of the gravity flow, operations commence on the third floor and progress downward toward the first. The second floor provides additional raw material storage, houses the control laboratories, and air conveyer equipment. The first floor includes general offices, cafeteria, machine shop, salvage, storage, receiving and shipping areas. The calender line is also located there. Planishing of the rigid sheets and sampling, inspection, and packing of all products are all first floor operations. About two-thirds of the first floor area is available for finished product storage.

Plasticizers are usually received at the plant in tank cars and are pumped from the cars at the car shed to any one of six all-welded steel storage tanks. These tanks are provided with U-bend type suction heaters which heat the plasticizer as it is withdrawn in order to lower its viscosity. Each heater is equipped with a self-operated temperature controller.

Three separate circulating systems, each with a pump, a supply header and a return line, are provided so that any of the plasticizers or lubricants can be used at any time. A drum unloading pit permits unloading for pumping to the storage tanks. Centrifugal pumps circulate liquid plasticizer through the insulated supply lines between the storage tanks and the weigh tanks. On its way, plasticizer passes through filters which remove dirt, rust or any solid contamination.

The purpose of the elaborate circulating system for plasticizers and lubricants is to eliminate handling and storage of a large quantity of drums and to allow the different plasticizers to be used conveniently at one time. The plasticizer is circulated continuously to correct any slight inequalities of properties, to assure a uniform product, and to prevent sludging or settling.

Stabilizers reach the plant in drums. These drums are kept in the raw materials storage warehouse on the third floor. They are withdrawn as required and added during the weigh-up operation.

Resins are delivered to the plant from Carbide and Carbon Chemicals Corp.'s plants at South Charleston, W. Va., or Texas City, Tex., in covered hopper-bottom cars or in carloads of five-ply paper bags holding 50 lb. each. In most cases they are handled in bulk for it is possible to ship more resin with less handling in hopper cars than in box cars. In addition, packaging costs and the possibility of contamination are minimized.

UNLOADING RESIN

A carefully worked out pneumatic handling system is used for unloading the resins, passing them over a scalping screen to insure freedom from contamination, and then conveying them to the 20 aluminum storage bins situated in the third-floor tower. Since the plant uses different kinds of resins which must be kept apart, both solvent and non-solvent types, there are two completely separate unloading systems, each having a capacity of 10,000 lb. per hr.

Two methods can be used to feed resin into the pneumatic system. If bagged resin is to be unloaded, the bags are taken from the box cars on pallets by means of a fork truck, dusted off, and opened carefully. The resin is then dumped manually into a portable stainless steel hopper connected to the pneumatic unloading line. A semi-automatic system is used for hopper cars. The car is first spotted under the unloading nozzle, and a derail, electrically interlocked with the unloading motors, is placed on the track. Without the derail in place no unloading can take place. The suction nozzle is next lowered manually into the resin. The suction hose runs over an overhead reel which is automatically controlled by the vacuum in the hose so as to maintain the proper submergence of the nozzle at all times.

All resin is collected in a receiving filter from which it passes by gravity through a rotary air lock onto a gyratory sifter installed in an 8 x 15 ft. pressure tank. Oversized particles are conveyed pneumatically to a centrifugal collector and dropped into an aluminum storage bin for salvage. The tank containing the screen operates under a positive pressure and is supplied with cooled air by a positive blower. This arrangement insures dustless screening, prevents the resin from heating, and provides air pressure for conveying from the screen.

Resin passing through the sifter screen drops into an injector and is conveyed by air through an aluminum and stainless steel pipeline up to one of the centrifugal collectors located above each of the 20 storage bins. Each bin has a filter-type breather to insure dustlessness.

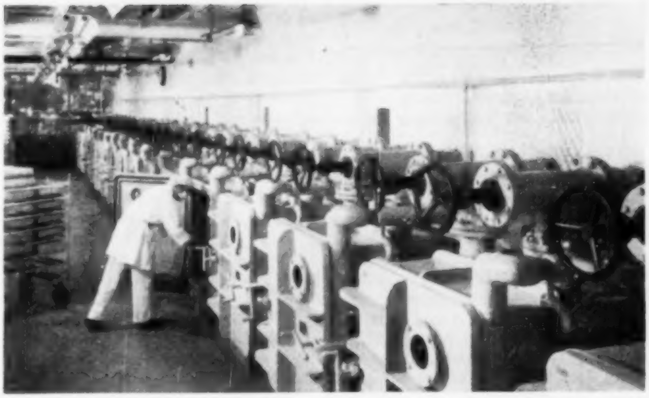
Resin is separated and drops by gravity into the bins. Exhaust air from the collector contains resin dust and is returned to a central filter-type dust collector which discharges the resin dust back to the sifter. Clean air from the dust collector is exhausted into the atmosphere. Each aluminum storage bin is provided with a tapering cone bottom and a discharge gate which is operated manually.

When resin is required from any one of the storage hoppers, it is discharged into one of several aluminum weigh lorries mounted on a scale and overhead electrified track systems. These weigh lorries are brought by tractors to any one of the blenders or to the resin chutes for discharge

(Continued on page 104)

A Century of Progress For Pfizer

Extensive research and the newest equipment point to achievements in the future as noteworthy as those in the past



VACUUM DRYING OVENS for the production of antibiotics, a major product.

One hundred years ago, in 1849, Charles Pfizer and Co., Inc., had its beginning toward becoming one of the major producers of fine chemicals. Through the past century the company has been a leader in the development of new chemical products, and today research is one of the most important phases of Pfizer's activities. Two special groups, biological and chemical research, work independently but with the common, coordinated goal of finding new or better ways to manufacture fine chemicals. The results are often combined in processes involving both fermentation and organic synthesis.

Some of the products manufactured during the company's first decade included santonin, iodine preparations, mercurials, borax, boric acid, refined camphor, and the tartars. Today, the extensive list of Pfizer chemicals includes, as well as some of the early products, antibiotics, vitamins, citrates, bismuth salts, oxalates, gluconates and others.

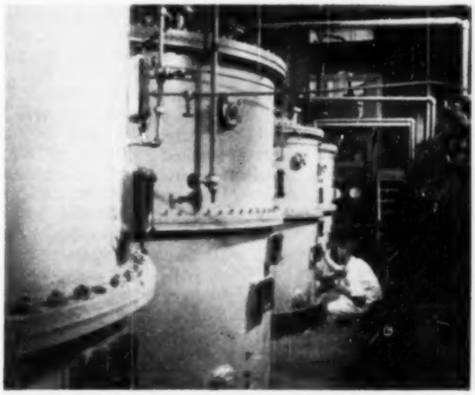
One of their early investigations was in the field of vegetative fermentation in 1914. By 1923 Pfizer was producing citric acid by this synthetic method on a commercial scale.

Following the first world war Pfizer developed a program directed toward the production of chemicals by organic synthesis. In 1929 gluconic acid was made available as a fermentation product at a price which warranted its more widespread application.

Early work, during the 1920's, on vitamins led to the development of a commercially feasible method of organic synthesis which was later successfully applied to the production of Vitamin C, Vitamin B_2 and others.

World War II led to production of penicillin (first brought to this country by two Oxford University scientists), streptomycin and dihydro streptomycin. Refinements in production methods led to great reductions in the cost of these antibiotics. Penicillin now sells at less than 1 percent of the original cost.

Current study is on the recently isolated Vitamin B_{12}, Bi-Con APF-6, used in animal and poultry feeds, and a new antibiotic, Neomycin. Work also continues on a number of other newly discovered antibiotics still in a laboratory stage of development. With this background of large scale production experience and a progressive research program, Pfizer will undoubtedly remain, in the future as in the past, among the leaders in progress in the field of fine chemicals.



VACUUM GRANULATOR in the citric acid plant.

VACUUM PANS used in benzene extraction of ascorbic acid.

Plastics Processing

(*Continued from page 102*)

to the mixers. Each hopper scale has an electrically operated printer for recording total net weight on a ticket.

COLORANT HANDLING

No other single operation in the fabrication of Vinylite plastics has greater effect on the quality and properties of the finished materials than the weighing and blending of colors. Exactness is essential. The colorants, furthermore, must be supplied to the final mixture in such a way as to insure perfect dispersion. Operations in the color blending department on the third floor, therefore, are all based on these two requirements.

Many of the colors are highly concentrated as received and they are used in extremely small quantities in the actual finished batch of vinyl material. This would make a difficult weighing job if it were not for a much used expedient. This is to dilute the concentrated color with a component of minimum color value. Thus, weighing is facilitated and a small error in batching will not make an appreciable difference in the finished product. The color blending department prepares such dilutions. They are known as "master batches," when they contain but a single color, or as "composites" when they contain more than one color or color combined with other ingredients. This department also prepares mixtures of some of the small scale ingredients and weighs out the prepared colorant master batches and composites used in the formulation of production runs. Such mixtures may be liquid, paste or dry.

For its blending operations this department uses a stainless steel muller type mixer for dry mixtures, or a pony mixer followed by a homogenizer. An interesting device is used to facilitate handling and insure safety in the division of the color components and other materials into small batches. This is a ventilated sheet metal and glass enclosed hood known as the composite weigh hood. It is equipped with three sets of scales for weighing, six hydraulically operated lifts for raising and lowering drums or other material containers at the weigh stations, and belt and roller conveyors for handling containers into which composites are weighed. Drums of materials to be used in the weigh-up are lowered from an overhead track system through doors in the top of the hood on to the hydraulically operated drum holders. This permits the operator to tilt the drums for ease in weighing.

The composite weigh hood is divided into three stations of two lift cylinders and one set of scales each. The first two are connected by a belt conveyor which makes possible the transfer of the receiving container between each station for four separate weighings. A spiral roller conveyor at the second and third stations transfers the container to a door in the front of the hood for removal. Circular openings in the glass window in front of each station make it possible for the operator to weigh without inhaling dust. Entrance to the back of the hood is possible through sliding doors.

Approximately 125 ft. of single overhead electrified track, with a switch and two hoists, is provided for conveying materials between the pony mixer, the homogenizers, the muller type mixer, and the weigh hood.

NON-RIGID PROCESSING

Blends for Vinylite flexible film are prepared by mixing resins with various plasticizers, lubricants, stabilizers and colorants in one of the blenders on the third floor. They are provided with dust-tight covers, a spray header pipe with atomizing nozzles, and a discharge opening closed by an air-operated sliding gate.

The dry ingredients including resin, stabilizers, filler, etc., are weighed out in one of the track-suspended weigh lorries which operate beneath the resin storage bins, the incremental and total weights being printed automatically by the lorry's scale mechanism. Some dry ingredients may, however, be added directly to the blender. The lorry is then discharged to the blender while the liquid part of the batch is being made up.

After the usual blending and milling, the plastic is conveyed to the calender located on the first floor. Here it is fed to the bite of the top set of rolls, formed into a continuous sheet of uniform thickness, color, and gloss by transfer through successive working through the calender train to the bottom take-off roll, and finally passes it on to cooling rolls of a take-off unit where it is trimmed to uniform width, cooled, and wound on fiber cores. Cored film is transferred from the take-off unit by means of a hoist and rail, removed from the mandrel, sampled, weighed, packaged, and placed on pallets for transfer to the finished product warehouse.

The calenders have four rolls, consisting of a vertical stack of three rolls, with an offset roll at the same level as the top roll of the stack. These calenders represent the first major installation of roller-bearing equipped machines in the plastics industry. Thickness of film is controlled by two-speed reversible electric motors which provide for rapid opening and closing of the top and bottom rolls or very slow movement to adjust thickness of film while it is being produced.

Within the limitations of motor speeds and reduction gear train, calenders are capable of infinite speed variation through electronic regulation of eddy current magnetic clutches. These connect the calender reducing gear with the four-speed a.c. motor.

PROCESSING RIGID PRODUCTS

Vinylite resin for rigid sheet is prepared in the usual mixers. The resin charge for the mixers is dropped from any one or more of the storage bins into a cylindrical weigh hopper. This hopper is moved on its overhead truck and discharged through a chute to the mixer. The liquid and small weigh-up ingredients are added directly by the operator.

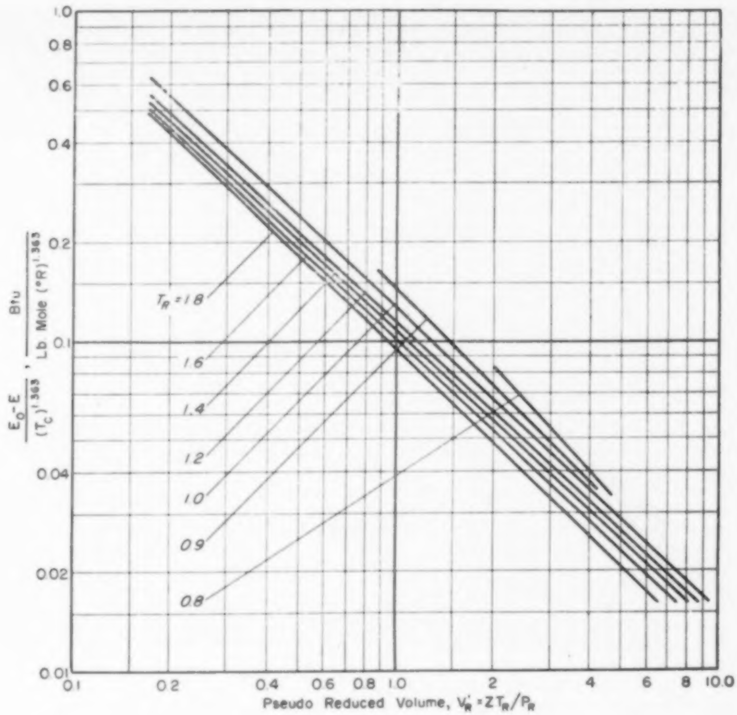
The final operation consists of passing it between mill rolls and transfer to the calender.

When continuous sheet is being produced, the product is wound on a core after leaving the calender and cooling rolls. The completed roll is wrapped in paper, packed in a fiber drum and sent by fork truck to the product warehouse.

When rigid sheets are made on the calender, the sheet is carried from the last cooling roll over an apron to the rotary cutter which is geared to the calendar and cooling rolls so as to cut sheets of predetermined width. The edge trim is also carried through trays at each side and is fed into trim choppers which cut the trim into small pieces. The chopped trim is collected in cans for re-use.

As the sheet is cut it drops into a storage box. The box is removed by the take-off operator and packed and closed for protection against dust, after which it is put on a pallet and removed to intermediate storage by fork truck.

The final operations on rigid sheets include smoothing and surface finishing (planishing), inspection and packing. (These operations are handled as described in the August 1946 article.) In planishing, the individual sheets are sandwiched between metal plates and stacked in a hydraulic press with the help of a hydraulic elevator. In the press, which is controlled automatically, the sheets are first heated and then cooled under pressure. The sheets are then trimmed to size, inspected visually and packed. The various stations use either ball or roller conveyor sections, depending on which conveyor type best fits the need for that particular operation.



THIS CHART gives the effect of isothermal changes on the internal energy of non-polar gases at high pressures.

Solves Internal Energy Problems

W. K. LEWIS and H. S. MICKLEY

Information concerning the effect of pressure on the behavior of chemical substances is indispensable in the evaluation of proposed high pressure processes and in the design of high pressure equipment. Although the engineer prefers to employ actual experimental high pressure data in his work, experimental results are frequently unavailable. As a practical substitute, the chemical engineer has attempted to develop general correlations which, although based on a limited amount of physical data, can be expected to apply to a wide number of materials. This paper deals with a correlation of this type. A new generalized correlation of the effect of isothermal changes in pressure on the internal energy of the non-polar gases is presented. The results of the study, in conjunction with the previously published compressibility factor[10, 11, 18, 24, 28] and fugacity[16, 18, 28] functions, provide the basis for predicting the influence of pressure on the volume, fugacity, enthalpy, internal energy, and entropy of gases; and hence, for predicting the effect of pressure on chemical processes.

Previous investigators[24] have pointed out that isothermal changes in internal energy can be correlated through the use of the reduced temperature and pressure, but such generalizations have not been published. Instead, correlations of isothermal changes in enthalpy have been presented[15, 28, 24]. Although valid and useful, the enthalpy correlations show marked curvature, and the isotherms are widely spaced. As a result, interpolation and extrapolation are difficult. This drawback is substantially eliminated in the correlation of the effect of pressure on the internal energy of gases proposed in this paper and shown in the chart.

The ordinate of the chart is the difference between the internal energy, E_o, at a fixed temperature and "zero" pressure and the internal energy, E, at the same temperature but at a higher pressure, divided by the critical temperature, T_c, of the material in question raised to the 1.363 power: $(E_o - E)/T_c^{1.363}$. The abscissa, called the "pseudo-reduced volume," V'_R is the product of the compressibility factor, Z, the reduced temperature, T_R, and the reciprocal of the reduced pressure, P_R: ZT_R/P_R. This term is proportional to the molar volume of a given substance since

$$V = \left[\frac{ZT_R}{P_R}\right] \left[\frac{RT_c}{P_c}\right] \qquad (1)$$

Each working line of the chart corresponds to a constant value of the reduced temperature.

In addition to the data already pre-

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sented in the literature[1-13, 15, 17, 20, 23] hitherto unpublished data[19, 21] obtained by the isothermal expansion technique rather than by indirect calculation from pressure-volume-temperature measurements, have been used in making the chart. Values of the compressibility factor, Z, were obtained from published data[14, 22].

An examination of the chart will show that, over a wide temperature range, the temperature variation of the function $(E_o\text{-}E)/T_c^{1.333}$ at constant values of the pseudo reduced volume is small. Further, the lines of constant reduced temperature are straight. These factors permit the data to be readily interpolated and extrapolated.

For non-polar gases, the correlation shows an average deviation of 5 percent from the available experimental data. Extrapolation of the generalized isotherms into the liquid hydrocarbon region yields values for the isothermal internal energy change for liquids that are in reasonable agreement with experiment[24]. As expected, data for the polar gases, such as steam, are not as well correlated by the chart as are the data for the non-polar gases. The true isotherms for steam are displaced somewhat from those shown on the chart and exhibit more curvature. The experimental hydrocarbon data indicate that the isotherms for reduced temperatures of 0.8 and 0.9 cross the isotherms for higher temperatures near a pseudo reduced volume of 7. This crossing has not been shown since it is believed to be due to uncertainties in the data. The intersection would occur in a region where the isothermal change in internal energy is small and relatively unimportant, and, further, where small absolute errors result in large percentage deviations. The experimental data for steam, which are probably the best available, do not indicate any intersection.

Use of the correlation is best illustrated by a specific example: it is desired to determine the change in the internal energy, enthalpy, and entropy of propane resulting from an isothermal change in pressure from 1 psia. to 2,470 psia. at a temperature of 540.31 deg. F. The critical temperature of propane is 206.26 deg. F. and the critical pressure is 42.01 atmospheres.

The reduced temperature is T_R =

$$\frac{540.31 + 459.69}{206.26 + 459.69} = 1.5.$$

At 1 psia, the reduced pressure is

$$P_R' = \frac{1}{(42.01)\,(14.696)} = 0.00162.$$

At 2,470 psia., the reduced pressure is

$$P_R'' = \frac{2,470}{(42.01)\,(14.696)} = 4.0.$$

From the generalized compressibility factor plots 14 or 23, Z_1 is approximately 1 and Z_2 is 0.806. Hence, $(ZT_R/P_R)_1 = 926$, and the chart shows the corresponding value of $(E_0 - E_1)/T_c^{1.333}$ to be substantially zero. $(ZT_R/P_R)_2 = 0.302$ and $(E_0 - E_2)/T_c^{1.333}$ is found to be 0.31. Hence, $E_2 - E_1 = T_c^{1.333}(-0.31) = (665.95)^{1.333}(-0.31) = -2{,}180$ Btu. per pound mole.

The corresponding enthalpy change may be found from the relations

$$H = E + PV \tag{2}$$

and

$$PV = ZRT \tag{3}$$

Hence, $H_2 - H_1 = E_2 - E_1 + RT(Z_2 - Z_1)$
$= -2{,}180 + 1.986$
$(1{,}000)\,(0.806\text{-}1) =$
$-2{,}565$ Btu. per pound mole.

The entropy change may be determined by the relation

$$dH = Tds + VdP \tag{4}$$

At constant temperature, equation (4) becomes

$$S_2 - S_1 = \frac{H_2 - H_1}{T} - \frac{1}{T}\int_{P_1}^{P_2} VdP \tag{5}$$

However, by definition, at constant temperature

$$\frac{1}{T}\int_{P_1}^{P_2} VdP = R \ln \frac{f_2}{f_1}, \tag{6}$$

where f denotes the fugacity. Values of the ratio f/P have been presented in a generalized correlation by Newton[18] and reproduced by Weber[23] and Dodge[14]. These references give $(f/P)_1 = 1$ and $(f/P)_2 = 0.765$. Hence,

$$\frac{1}{T}\int_{P_1}^{P_2} VdP = R \ln \frac{f_2}{f_1} = \frac{(0.765)\,(2{,}470)}{(1)\qquad(1)}$$

= 14.95 Btu. per pound mole per degree Rankine,

and

$$S_2 - S_1 = -\frac{2{,}565}{1{,}000} - 14.95 =$$

-17.52 Btu. per pound mole per degree Rankine.

The correlation shown in the chart provides an insight into the type of forces responsible for the variation of internal energy with pressure. The finding that the isotherms are closely spaced straight lines indicates that the attractive forces between the molecules are primarily a function of the distance between the molecules and a second order function of temperature. The fact that the correlation represents the behavior of the non-polar gases quite satisfactorily and predicts the correct order of magnitude for a polar gas such as steam and for liquids, suggests that the general behavior of the attractive forces between molecules is the same for all materials.

Nomenclature

- E = Molal internal energy at temperature T and pressure P, Btu. per pound mole.
- E_o = Molal internal energy at temperature T and zero pressure, Btu. per pound mole.
- f = Fugacity, pounds per square inch absolute.
- H = Molal enthalpy at temperature T and pressure P, Btu. per pound mole.
- P = Pressure, pounds per square inch absolute.
- P_c = Critical pressure, pounds per square inch absolute.
- P_R = Reduced pressure, $P_R = P/P_c$, dimensionless.
- R = Gas constant, numerical value of 10.71 in units of pounds force — cubic feet per square inch — degree Rankine — pound mole.
- S = Molal entropy at temperature T and pressure P, Btu. per pound mole per degree Rankine.
- T = Absolute temperature, degrees Rankine (°F + 459.69).
- T_c = Critical temperature, degrees Rankine.
- T_R = Reduced temperature, $T_R = \dfrac{T}{T_c}$, dimensionless.
- V = Molal volume, cubic feet per pound mole.
- V'_R = Pseudo reduced volume, $V'_R = \dfrac{ZT_R}{P_R}$, dimensionless.
- Z = Compressibility factor, dimensionless.

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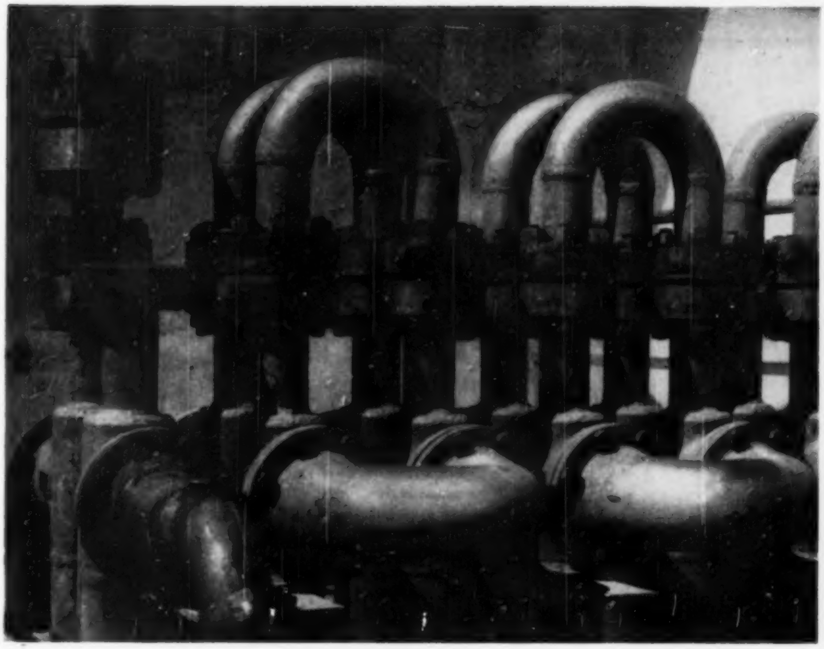


HIGH PRESSURE

New applications, new companies in the field, new fabrication techniques have changed the picture in high pressure processing. Here, in the first comprehensive report on high pressure techniques in many years, are the changes. Here are the up-to-date designs, the engineering used in today's high pressure plants.

CHEMICAL ENGINEERING REPORT—AUGUST 1949

It has been 19 years since *Chemical Engineering* undertook a full scale survey of high pressure techniques in chemical processing. At that time, applications were pretty much limited to production of ammonia and methanol. Since then applications have expanded tremendously. Since World War II there has been the development of polyethylene to full commercial scale, application in the United States of the German developed OXO process, and the production of ethanol by high pressure hydration of ethylene. The techniques involved are no longer limited to a few companies, a few engineers.

A DEFINITION

Just where low pressure stops and high pressure starts is an open question. For purposes of this report, we have assumed the dividing line occurs at a pressure of 750 pounds per square inch gage.

In surveying the current status of high pressure chemical processing it has been impossible to go into much desirable detail — books can be and have been written on the subject. Here, then, is a critical review of the recent advances in high pressure techniques.

In turn, the application of high pressure to chemical

processing has two aspects which will be treated separately below. The first is the growth in the number of applications and the use of even higher pressures. The second is the engineering know-how and design of equipment for high pressure processing.

Installing coal hydrogenation converter shows huge size of high pressure equipment.

APPLICATIONS FOR HIGH PRESSURE

Over the past 20 years there have been a tremendous number of new applications for high pressure processing. That is perhaps the most significant point that can be made. In 1930, the dollar value of products produced at high pressure (excluding petroleum processing) was about $50,000,000. Today it is probably $225,000,000. Perhaps it will be valuable to trace briefly this growth.

In 1930 there were two great high pressure chemical plants in the United States—the ammonia plant of Allied's Solvay Division at Hopewell, Va., and Du Pont's ammonia and methanol plant at Belle, W. Va. Today these plants are still as large as any in the high pressure business.

New uses came in 1930's

As the 1930's began, the real diversification of high pressure chemical operation started. Du Pont's Ammonia Department, or the Du Pont Ammonia Corp. as it was then called, was the leader. Before 1930 it was producing ammonia, methanol, higher alcohols, and sodium formate. The latter product was never completely successful from an economic point of view and the plant has since been shut down.

During the early 1930's Du Pont introduced urea, made by reacting carbon dioxide and ammonia at 400 atm. Then in brief order came acetic and propionic acids, produced by catalytically reacting alcohols (methanol and ethanol respectively) with carbon monoxide. These latter reactions involved higher pressures.

A concurrent move in the high pressure field followed earlier work in the petroleum field—hydrogenation. Here Du Pont, Hooker, and others began to hydrogenate natural oils to alcohols. Later came hydrogenation of nitriles to amines and aromatics to alicyclics. In most of these cases, as in the petroleum hydrogenations, the operating pressure was around 5,000 psi. (350 atm.).

The early hydrogenation units operated batchwise. Today there is a move toward continuous hydrogenation, a move dictated by increasing outputs of single products. The smallness of production of individual chemicals, and the ability to make several products in the same unit were reasons for the early batch operation.

Prior to the war another chemical began production at high pressure, again by Du Pont. This was methyl formate, made by reacting methanol and carbon dioxide under lower pressure and different conditions than the acetic acid synthesis. This methyl formate was then converted to formamide and to hydrogen cyanide as the basis for methyl methacrylate (Lucite) production.

Recent war caused changes

With the advent of World War II, two things happened. The first was a great extension in the number of companies dealing with high pressures. The second was the advent of commercial operation at pressures above 1,000 atm.

Beginning even before Pearl Harbor, the expanded preparedness program ran up against lack of ammonia—to be converted into nitric acid and then explosives such as TNT. To increase ammonia production the Army naturally turned to the established ammonia producers. The result was Du Pont's construction and operation

of the Morgantown Ordnance Works, and Allied's construction and operation of two ordnance plants, Ohio River and Buckeye.

New companies come into the field

As even more ammonia was needed other companies came into the picture. Some had previous high pressure experience with small ammonia or methanol plants—Mathieson, Hercules, Commercial Solvents. Others were strictly new to the high pressure field—Spencer, Lion Oil, TVA. This diversification greatly broadened the base of high pressure experience. It brought new approaches to high pressure operation, new thinking, some new engineering developments.

The second wartime development was use of higher pressures, commercial operation as high as 2,000 atm. This came as a result of the British development of polyethylene—a plastic with tremendous wartime use in radar and great postwar possibilities. In this country two producers started polymerizing ethylene—Du Pont at 1,000-1,500 atm. and Carbide & Carbon at 2,000 atm. The latter plant is probably the highest commercial operating pressure today, although there are rumors that a classified plant is operating at 3,500 atm. Even if the latter rumor is true, the plant may be only a pilot plant.

Methanol produced at lower pressures

This development of even higher pressures is diametrically opposed to a trend in ammonia and methanol production that deserves mention. For many years Du Pont was an advocate of 1,000 atm. for ammonia production while Allied operated at 350 atm. But during the war all the ordnance plants except Missouri (Hercules) and Morgantown (Du Pont) operated at the lower pressure. Now it seems apparent that the lower pressure is more economic. Du Pont's postwar methanol plant, its Sabine River Works at Orange, Tex., is operating at 350 atm.

Since the war two new processes have gone into operation at high pressures—the much publicized OXO process and direct hydration of ethylene to ethanol.

OXO process is new high pressure use

The OXO process, originally developed in Germany, involves reaction of one mol of an olefin with one mol of hydrogen and one mol of carbon monoxide. The process operates at about 3-5,000 psi. The chemistry involved is roughly the following:

$$-\overset{|}{C}=\overset{|}{C}- + CO + H_2 \rightarrow -\overset{|}{C}H-\underset{CHO}{\overset{|}{C}}-$$

At least three companies are now using this process commercially, and others have plants building or are considering the process. Rohm and Haas has a small plant using diisobutylene as the olefin. It is producing 3,5,5-trimethylhexaldehyde, from which it produces a whole series of acids, aldehydes, amines, and cyanohydrins.

Du Pont's Ammonia Department at Belle, W. Va., is carrying out the same reaction on a larger scale. It is hydrogenating the product aldehyde, however, and is offering the alcohol (trimethylhexanol) for sale. Du Pont did not build a new plant for this purpose, merely modified an existing unit. Tank car quantities are being produced, however.

The third user is Esso Standard Oil Co. at Baton Rouge, La. Its product is iso-octyl alcohol. Plans are under way for a unit to produce 30,000,000 lb. per year.

Direct ethylene hydration new too

Production of ethanol by direct hydration of ethylene at high pressure has been researched by many companies over the past decade. The first commercial unit has been put in by Shell Chemical at Houston, Tex. In this unit, ethylene and steam are reacted at just below 1,000 psi. pressure using phosphoric acid catalyst. The unit gave trouble at first, but operations are reported to be satisfactory now.

The above applications have been primarily chemical. There are a series of high pressure operations in the petroleum refining field that are analagous and deserve mention.

Petroleum refiners use high pressure

Hydrogenation in petroleum refining was mentioned above. In general the pressure used is 3,000-5,000 psi. The biggest wartime use of high pressure hydrogenation was in production of iso-octane as a blending agent for aviation fuel. High grade diesel fuel can be made from low quality gas oils by hydrogenation.

Catalytic polymerization is another use of high pressures in refining. The operation is the polymerization of propylenes and butylenes to gasoline. The pressure used is 1,000-1,200 psi. In another process, the Isomate process, pentanes and hexanes are isomerized at about 800 psi. with a catalyst consisting of aluminum chloride and hydrogen chloride.

In both adsorptive and absorptive drying of gases the pressures used by the petroleum refiner reach the high pressure range, running 750-1,000 psi. Pressures as high as 1,500 psi. are used to recover the heavier molecular weight portions of natural gas, while injection plants for recycling natural gas back into the ground run as high as 5,000 psi. Natural gas pipelines also reach the high pressure range.

Future processes forecast

But what of the future? Research is active all over the United States on new applications for high pressure. Work of the Bureau of Mines at 10,000 psi. will be discussed below. Du Pont is continuing research in the 5,000 psi. range, is also actively researching new products that will require 30,000 psi. Du Pont's long range research is even as high as 100,000 psi., although no practical new processes are expected soon. This work will have mainly a mechanical approach. Hercules is working at 10,000 psi. Carbide is researching at 30,000 psi., American Cyanamid at 5,000 psi., and Standard Oil of N. J. also at 5,000 psi.

Few companies will say what type of reactions are being researched. However, there are some leads. It seems certain that analagous OXO reactions to those in commercial production are being worked on, possibly at far higher pressures. Standard Oil Development is studying the reaction of benzene with methane at 13,000 psi., looking for a toluene synthesis. At Yale, Professor B. F. Dodge is investigating the catalytic reaction of carbon monoxide with diols to produce dibasic acids, and catalytic vapor-phase oxidation of aromatic hydrocarbons. Other reactions he expects to study under high pressure include the direct oxidation of ethylene to ethylene glycol and the oxidation of other than aromatic hydrocarbons.

It would appear that the advent of poly-

ethylene, and this method of polymerization, must have stirred research on other polymers which might be made by similar techniques. For instance U. S. Patent 2,388,225 mentions some 40 chemicals or groups of chemicals which can be copolymerized with ethylene at high pressure. A whole series of patents (U. S. Patents 2,395,-381; 2,434,145; 2,436,080; 2,451,963; 2,448,946; 2,448,978; British Patents 576,913; 576,830; 597,833; 607,911) specifically refer to the copolymerization of ethylene with vinyl acetate.

New application coal hydro

Perhaps the biggest new application for high pressure is coal hydrogenation. This spring the Bureau of Mines started operating its demonstration plant at Louisiana, Mo. This plant is expected to produce the design data needed to evaluate the economics of large-scale coal hydrogenation. The process has generally been ranked behind Fischer-Tropsch and shale oil economically, but the Bureau of Mines is becoming more and more optimistic about it.

So has one other company—Carbide. It is generally known that Carbide has been experimenting with coal hydrogenation for some time. Just why is an open question. However, trade sources say that Carbide has authorized an $8-10 million plant to be installed at Institute, W. Va., for coal hydrogenation. It may be that Carbide expects to develop a new organic field—multi-ring compounds. The oil from coal hydrogenation is full of naphthenic, anthracenic and other multi-ring compounds. The previous supply of these has been solely the small amounts contained in coal tar from coking.

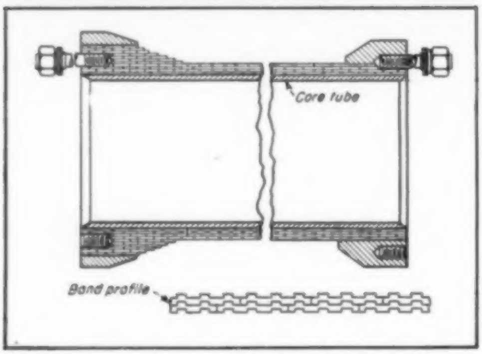
These are but hints of future high pressure applications. There are sure to be others.

We come now to the second major section of this report, the design of high pressure equipment. Here it is impossible to go into detail on methods of designing such equipment. What we have endeavored to do is present the most up to date thinking of high pressure experts, show examples of the latest designs, point out the new developments.

Bureau of Mines helps

For much of the material below we are indebted to the Bureau of Mines. The Bureau has been generous in releasing details of its coal hydrogenation plant units. Credit for the designing must be split between the Bureau and the Bechtel Corp. who did much of the design and constructed the plant. Companies operating plants at high pressure will give out little information on their designs, considering such information as valuable know-how. Some information does get out, as in the case of the delta gasket to be described below.

In considering equipment, this section is split into several parts, covering in succeeding sections: vessel manufacture, vessel and tubular reactors, separators, heat exchangers, vessels closures, valves, compressors and pumps, and instrumentation.



Tape-wound vessel construction, developed in Germany, is coming thing according to some experts.

VESSELS FOR HIGH PRESSURE

High pressure vessels can be considered from several angles: the method or type of construction, the use to which they will be put, whether they are in effect vessels or more accurately long tubes. Suppose we consider the method or type of construction first.

Most high pressure vessels are heavy-walled steel units, ranging in size from small high pressure shaker tubes to huge reactors several feet in diameter and 50 ft. tall. Both the size and the pressure involved will dictate the type of construction used.

Five methods of building vessels

In general there are five types of construction used for pressure vessels: (1) a solid walled vessel produced by forging or boring a solid rod of metal, (2) a bent sheet of metal with a single longitudinal weld, (3) a vessel built up of several layers, either by shrinking on successive cylinders one over the other, or by welding the successive cylinders under stress, (4) a vessel built up by a wire winding around a central cylinder, and (5) a vessel built by wrapping a central cylinder with successive layers of an interlocking tape.

Of these possibilities, the first three are of major importance in the United States. The fourth has never been too successful. The last, developed in Germany, may get a trial in the United States soon.

Considering size as a limitation alone, small vessels are almost always of solid construction. In

very small sizes, such vessels are merely sections of heavy walled tubing. All in all, solid construction dominates in vessels less than 12 in. in diameter. It is in the larger vessels that competition between the manufacturing methods comes into play.

In considering large vessels the place of each method of construction is not too clear. For similar applications, different companies will choose different methods. It is apparent that there is no unanimity of opinion on the merits of the methods. It would perhaps be worthwhile to consider the merits and limitations of each of these methods separately.

Forgings most prevalent

1. *Solid Forging*—Probably more high pressure vessels have been built by solid forging than by any other method. The method is straightforward, equipment is available, formulas are available for calculation of required wall thickness. Basically there is only one limitation to the use of such vessels, other than the always present economic competition with other methods. The limit is on the size of vessels of this type and is set by the forging capacity available. In this country this means a maximum of about 100 tons weight.

2. *Welded Vessels*—Vessels built of a single sheet, bent and welded longitudinally are very common for the lower pressures. To some degree they are limited by the strength and adequacy of the weld, but they are limited more by the thickness of the steel sheet which must be bent, a maximum of about 6 in. In general there are few applications above 4,000 psi. although such construction predominates below that pressure.

Layer vessels widely used

3. *Layer Construction*—Construction of a heavy wall in layers has several advantages, the major of which is that there is no limitation on the vessel size. One method of construction, by the A. O. Smith Corp., is done as follows:

Each layer, usually in half-sections, is progressively wrapped by mechanical means around an inner cylinder ¼ to ½ in. thick. These layers are then welded together at the longitudinal edges. Rings are inserted in the ends to hold the inner shell round while subsequent layers are added. These subsequent layers are generally less than ¼ in. thick.

The combination of the wrapping load imposed, plus the weld shrinkage, tends to produce compression in all of the layers except the outer layer, which is in tension. In theory, this successive wrapping with tension on the new layer produces a stress inward throughout the cylinder wall when there is no pressure on the vessel. Then when the pressure is aplied, the stress relationship tends toward normal. This should result in ability to use a thinner wall on the vessel, hence less weight to the finished unit. There is some question whether or not this advantage is always utilized.

German tape wound vessels look good

4. *Wrapped Vessels*—One of the more interesting developments in pressure vessel fabrication came about just before World War II. It was developed in Germany and is generally termed the Wickelhofen method. The method is competitive in essence with the layer type vessels in that the cylinder wall is prestressed and tends to assume a neutral stress when the vessel is under pressure.

The vessel is built as follows: An inner cylinder is placed on a lathe, with the ends of the cylinder suitably supported by rings. The cylinder is then wrapped with a tape, which is grooved with a series of grooves that will interlock with succeeding layers of tape. The succeeding layers are offset from the preceding ones to get a real interlock and produce axial strength.

As the tape is wound on the cylinder it is electrically heated to 600-850 deg. C. and is cooled to atmospheric temperature just after being pressed onto the preceding layer. The shrinkage due to the drop in temperature sets up the stress within the vessel wall.

None being made yet in U. S. A.

At present, no one is fabricating these vessels in the United States. German vessels of this type have been brought to the United States for study and it is understood that Du Pont is purchasing at least one new vessel in Germany for test purposes. Bethlehem Steel Co. has been studying the possibility of building such vessels but has not yet installed the necessary equipment, as far as is known. The company will not discuss its plans along this line. Midvale also has been reported considering production.

Relative economics depends on pressure

Economics—The relative economics of these four types of vessels are an open question. One authority says that layer construction is the best by far above 4,000 psi. Another says he does not like them at any pressure. The consensus seems to be that: (1) Welded vessels should be used below 4,000 psi.; (2) Layer vessels are most economical in the 5-6,000 psi. range; (3) Forged vessels are most economical above 7,000 psi., with layer vessels being used if the vessel is larger than 100 tons total weight; (4) Strap wound vessels are a somewhat unknown quantity and probably will compete in the upper pressures, above 5,000 psi.

In choosing a vessel for the higher pressures, it is usual to get quotations on both the layer and forged types. The degree to which equipment is tied up on other orders will sometimes indicate which of the types is most economic, rather than any mechanical advantage that one or the other type has.

In considering vessel manufacture, one other method and one new problem deserve mention.

Autofrettage is new technique

When laminated and strap wound constructions were discussed above, the advantage of prestressing was indicated. There is another way of getting prestress that so far is not commercial for chemical pressure vessels. That technique is autofrettage. This technique involves taking a solid forged vessel and applying extreme internal pressure. Such pressures are used that the internal diameter increases up to a maximum of 2½ percent. When the pressure is removed, the elasticity of the metal puts the inside layers of the vessel under stress inward, giving a similar prestressed condition to that obtained in layer construction.

This autofrettage method has been widely used in building gun barrels with autofrettaging presures on the order of 100,000 psi. However, there are considerably differing opinions

in industry on the application of autofrettage to commercial vessels. Some think that it is a coming thing. Others feel doubtful due to the difficulty of calculating the prestress obtained on the ends of vessels and around the heads and connections. The whole subject seems to be in a state of flux.

Hydrogen permeability will be a problem

The problem mentioned above is one that will be encountered when commercial pressures reach 3,000 atm. (45,000 psi.)—hydrogen permeability. In the early years of ammonia synthesis, hydrogen attack on steel was a problem. At the pressures and temperatures, involved, hydrogen would attack the carbon in the steel, leaving a weak shell which might lead to failure. The problem was licked by using alloy steels containing chromium.

The new problem sounds like the old one, but it is not. It is hydrogen permeability—or hydrogen embrittlement. The mechanism is not known, but here is one possibility: hydrogen within the vessel, at the surface of the metal wall, converts to atomic hydrogen. These hydrogen atoms are so small they can easly penetrate between the metal crystals. As the hydrogen penetrates the metal it may find a slight flaw, or hole in the metal. At that point it can revert to molecular hydrogen and build up a pressure in the flaw equal to the pressure inside the vessel. As this pressure builds up in a group of closely-situated flaws, or in a flaw near the vessel outer surface, rupture and failure of the vessel can occur. So far there is no answer to the problem. The answer may be found in special methods of heat treatment. Also so far the effect cannot be predicted, apparently similar vessels failing at radically different pressures.

As yet hydrogen embrittlement is not a commerical problem—pressures have not gone that high. But with the amount of research going on at higher pressures, the problem is bound to be faced in the next few years.

Wall thickness design methods elsewhere

In discussing vessel manufacture we have not discussed the design formulas that are used to calculate necessary wall thickness. One reason for this is the series of articles by Maccary and Fey (see p. 96) which begin in this issue. This series will review the various methods used, for designing forged and prestressed vessels. Another reason is that there has been little recent development in design methods, the Lamé formula still being the basis for calculation.

Design of closures, or heads, for pressure vessels is discussed in a section of this report farther on.

REACTORS FOR HIGH PRESSURE

In general, there are three different uses for pressure vessels: reactors, separators or receivers, and heat exchangers. In turn, reactors can be divided several ways. First there is the difference between batch and continuous reactors. Then, too, continuous reactors can be divided into those which are truly vessels and those which are more accurately described as tubular. The latter are almost never operated batchwise.

Most batch reactors similar

Most batch reactors are termed autoclaves. Commonly they are a vessel with an integral bottom and with a removable head, containing entry for materials to be reacted, heating and cooling media, and often a method of agitation. Since the vessel wall is thick, heating and cooling is usually obtained by the use of coils within the vessel. Agitation is usually by means of propellers (or veined disks, etc.) on a rotating shaft which passes through the head. On laboratory autoclaves (shaker tubes) the agitation is often accomplished by shaking the entire vessel.

Reactors such as this are often used in reactions between a liquid and gas, particularly where the catalyst used is solid. Many natural oil hydrogenations are handled this way. The catalyst is held as a slurry in the oil, and the unit is pressured with hydrogen. Hydrogen is continuously added to the unit to maintain a constant pressure, the rate of gas addition slowly falling off as the reaction becomes completed.

One of the problems that usually affects design of continuous reactors is the temperature.

Vessel walls must be kept cool

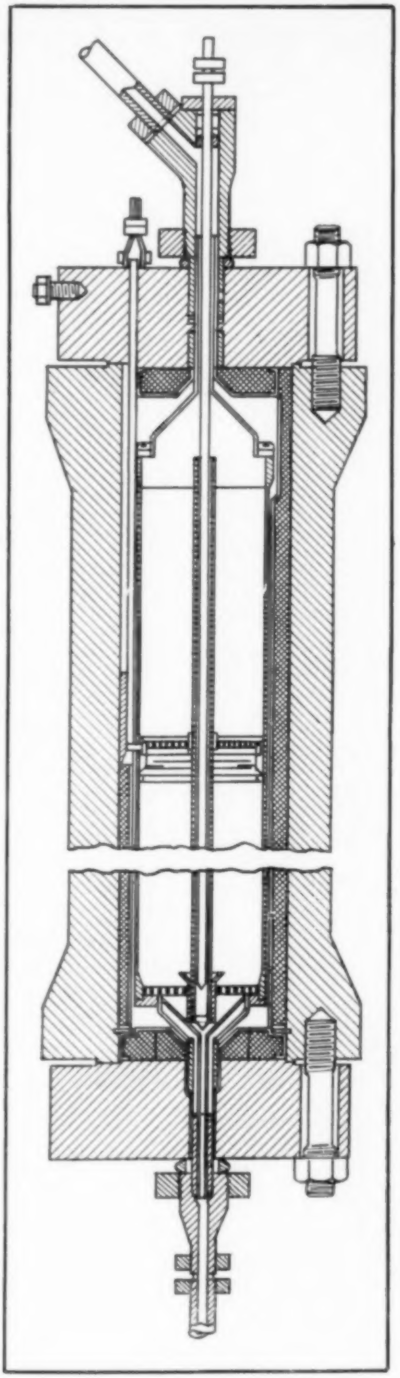
In general the temperature of a vessel wall should be maintained below 200 deg. C., and preferably no higher than 100 deg. C. However, ammonia synthesis may run as high as 500 deg. C. and coal hydrogenation operates at the same temperature. Vessel walls would have to be much thicker if subjected to these temperatures, and "creep" could be a serious factor. Also hydrogen attack is a bigger problem at higher temperatures.

There are in general two different methods of maintaining cool walls. The first is used by the Bureau of Mines in its coal hydrogenation converters—internal insulation. These converters have a three inch lining of asbestos cement. The second, used on ammonia and methanol converters, is to pass cool, incoming gas along the wall. This technique can only be used with internal heat exchange to bring the gas to reaction temperature.

The usual ammonia or methanol converter contains a catalyst basket, a heat exchanger, an electric start-up heater, and a "cold shot" connection. The cool, incoming gas passes down the periphery of the shell, up through the heat exchanger and through tubes in the catalyst bed, down through the catalyst, back through the heat exchanger the other way, and finally out of the reactor. Actual designs are legion and are aimed at getting a greater catalyst volume in a given reactor volume as well as at low pressure drop. The electric heater is used during start-up to bring the gas up to reaction temperature.

Tubular converters different

Tubular, high pressure converters are an entirely different proposition. They are usually used where the catalyst is gaseous or liquid, and where there is considerable heat of reaction to be removed. They gain agitation by the turbulence of the gas and/or liquid stream. Heat transfer is through the walls of the tube. In fact the whole converter may be built like



Vapor phase coal hydrogenation converter is 39 ft. tall, 32 in. I. D., 49½ in. O. D., is solid forging.

a double tube heat exchanger. There have not been too many applications of this type of converter. One, however, is worth considering —production of polyethylene.

Making ethylene polymer an example

Although it is the newest and most interesting recent application of tubular converters, little has been published about ethylene polymerization. More than that, the three companies involved—Du Pont, Carbide and Carbon, and Imperial Chemical Industries—are reluctant to give out much information. However, the patent literature is quite complete and offers a glimpse of the processing techniques.

The polymerization reaction has certain characteristics which tend to dictate the type of reactor used. The pressure involved is usually over 500 atm., the temperature in the neighborhood of 200 deg. C., the reaction is exothermic, and the catalyst used is oxygen. Commercially it is reported that D Pont operates at approximately 1,000 atm. and Carbide at 2,000 atm., the highest commercial pressure operation in the United States. From the patent literature it appears that Du Pont and Carbide operate with different type of polymerization. Carbide operates completely in the gas phase, while Du Pont polymerizes with water and benzene present in the reactor.

Carbide process is gas phase

Carbide described their process as follows in a recent patent (U. S. Patent 2,433,045): "A rapid and continuous polymerization has been found preferable for large quantity production of this resin, and in such operation the polymer may be recovered from the reaction zone by discharging it with the unreacted ethylene gas through a presure release valve, and collecting the polyethylene in a filter or gravity settling chamber. . . . In a typical operation the ethylene polymerization reactor is held at a temperature of 200 to 300 deg. C. and at a pressure in the neighborhood of 20,000 to 35,000 psi. The unreacted ethylene, which in a rapid reaction usually amount to 80 percent or more of the gas introduced to the polymerization zone, is exhausted continuously, or intermittently. . . . In accordance with the invention I propose to collect solid polyolefines in extruded form by a process continuous with the polymerization, and by utilizing the temperature and pressure of the gas leaving the reactor for effecting the extrusion. This is accomplished by releasing the unreacted olefin gas, in which the polymerized product is entrained, from the high pressure reaction zone directly into a collection vessel of dimensions sufficient to permit substantial gas expansion and separation of the polymer from the gas. The temperature of the released gas is maintained at a point which will keep the resin in a plastic state, and the pressure is controlled within a range sufficient to extrude the resin through suitable dies into rods, filaments or other forms. The cooled and hardened extruded material can then be comminuted as desired to provide a physical form of the resin suitable to conven-

tional fabrication with a minimum of further handling."

Du Pont process described

From the patents again, it appears possible to get an idea of the Du Pont process (Br. Patent 583,850): "The reaction . . . is carried out . . . in a pressure-resisting tubular converter of relatively great length to cross section. It has been found that in such a converter the reaction can be satisfactorily controlled, and it may be accurately controlled by employing adiabatic heating means. Preferably the ethylene and oxygen or per-compound catalyst at proper temperature and pressures are introduced into the converter together with a heat absorbing liquid which effectively absorbs the heat of reaction and at the same aids in thoroughly mixing the reactants while in the reaction zone. Thorough mixing provided in this way performs a dual function; first, it gives intimate contact between the ethylene and the oxygen or per-compound catalyst thereby accelerating the reaction, and second it prevents the polymer as formed, which under the temperature and pressure conditions is generally a sticky, highly viscous mass, from building up on the walls of the converter thereby plugging the passage and/or effectively cutting down heat transfer through the walls of the converter.

Both liquid and gas phases present

"In order to affect the above advantageous result a fluid may be introduced with the ethylene, and preferably a fluid which is liquid under the conditions of the reaction is introduced in such quantity that it will give turbulent flow instead of streamline flow in a continuous process carried out in the converter used. . . .

"The fluids which may be used in order to provide agitation and effective scouring of the interior of the converter include benzene, toluene, chlorobenzene, isooctane, methanol, ethanol, and more particularly water. . . . The reaction will operate smoothly with the production of polymeric products in excellent yields and of unexcelled quality when water is used in conjunction with benzene, particularly with benzene in amounts ranging between 2 to 15 percent of the water present. . . .

Converters are not horizontal

"When the process of this invention is carried out with the introduction of a fluid to give turbulent flow, it is advantageous to arrange the tubes of the converter so that they are not horizontal. It has been found that if a converter tube is placed in a horizontal plane there is a tendency toward stratification, with a lower liquid and an upper vapor layer whereby adequate agitation is not obtained and consequently poor results are realised. By tilting the tubes at an angle of at least 2 percent to the horizontal, stratification is eliminated even with low input of the fluid and the deleterious results attributable to stratification wholly eliminated. With such conditions, the point of admission of the reactants is at a lower level than the point of exit of the products from the converter."

An indication of the type of converter possibly used can be gained from a recent ICI patent (Br. Patent 583,805):

"The polymerization of ethylene was conducted in a pressure-resisting tube having an internal diameter of $\frac{5}{16}$ in., an external diameter of $1\frac{1}{2}$ in., and an overall length of 88 ft. Means were provided for the introduction of materials into the reaction zone at a point 12 ft. from the entrance of the tube, at a second point spaced $17\frac{1}{2}$ ft. from the first, and at a third point spaced $21\frac{1}{2}$ ft. from the second. *(Note—these could be used as "cold shot" addition points)* Ethylene containing 20 parts per million of oxygen was introduced at a rate of 17 lbs. per hour under a pressure of 1,000 atm. into the entrance of the converter together with 18.1 pph. of benzene and water at the rate of 25.4 pph., containing 100 parts per million of oxygen and preheated to a temperature of 179 deg. C. There was introduced into the converter at the first point after the entrance water at a rate of 26.4 pph. containing 100 parts per million of oxygen and heated to a temperature of 172 deg. C.; at the second point water at a rate of 22.2 pph., containing 85 parts per million of oxygen and at a temperature of 172 deg. C.; and at the third point water at a rate of 25.4 pph., containing 100 parts per million of oxygen and heated to a temperature of 176 deg. C. The tube was initially brought to reaction temperature of approximately 190 deg. C. by external heating means. The reaction products issuing from the tube were continuously let down to atmospheric pressure and the polythene recovered, 17.1 percent of the ethylene being found to be converted into polythene. This process may and has been rendered continuous by recompressing the unconverted ethylene and reintroducing it continuously with 'make-up' ethylene into the converter."

Several ethylene addition points

Stainless steel used

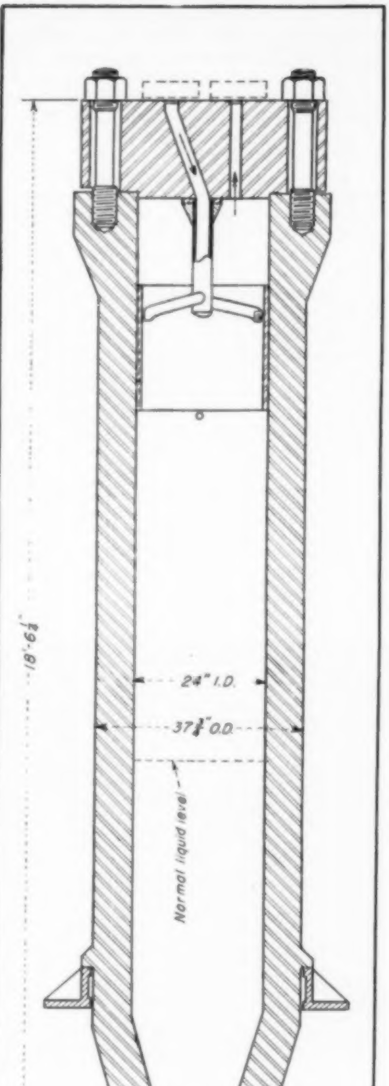
Another patent (U. S. Patent 2,394,960) indicates that the converters are made of stainless steel containing 18 percent chromium and 8 percent nickel. Whether or not the converters are molybdenum modified is not mentioned in the patents, but it is likely.

SEPARATORS FOR HIGH PRESSURE

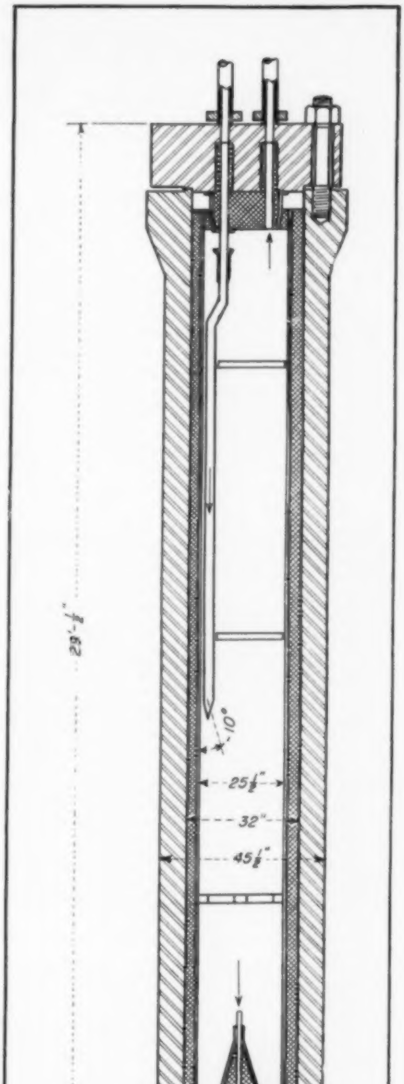
Another common type of pressure vessel is the separator. In many continuous high pressure reactions both a gas and liquid phase are present in the product stream. The liquid may be the reaction product of a purely gas reaction, as in synthesis of methanol, or it may be one of the reactants, as in coal hydrogenation.

Design of high pressure separators involves the same problems as a low pressure separator—a means of introducing the mixture into the middle of the unit, allowing time for separation, aiding it with centrifugal action if needed, taking the gas off the top, and taking the liquid off the bottom. Two designs used by the Bureau of Mines are illustrated here, one of which operates at high temperature, 500 deg. C., and the other at low temperature. Both operate at approximately 10,000 psi.

The real problem in designing and operating



Low temperature separator of the Bureau of Mines needs no interior insulation, has wear plate.



High temperature separator has insulation inside, hydrogen bubbler at bottom to prevent coking.

high pressure separators is to determine and control liquid level. The methods used by the Bureau of Mines will be discussed farther on in this report.

Another problem, just as in low pressure separators, is erosion. This can be taken care of by replaceable wear plates, as in the illustrated design.

HEAT EXCHANGERS FOR HIGH PRESSURE

The problem involved in designing high pressure heat exchange equipment is the thickness of the metal wall required to withstand the pressure. This often tends to cut down the heat transfer rate considerably, even though most of the resistance is in the film coefficients. Also the thick walls are costly in themselves.

Most exchangers double tube type

The usual result has been that high pressure exchangers are of the double tube type. When strictly heat exchangers are the case, not coolers or heaters, this is almost always the case. The reason is that the central tube has no more pressure across it than the pressure drop in the equipment between the heating and cooling process.

An example of this type of exchanger is the liquid phase exchanger of the Bureau of Mines. Here the outside pipe is 4½ in. O.D. and 1.005 in. wall thickness. In contrast, the inner tube is 1¼ in. O.D. but has only 8 gage wall thickness. The pressure involved is 10,300 psi. but only the differential pressure is involved across the internal pipe.

Coolers may be shell and tube

When it comes to coolers, on the other hand, there is some question of the relative economics between a double tube and a shell and tube bundle type. At Louisiana, Mo., the Bureau of Mines is going to test both.

The double tube cooler reduces a gas stream from about 600 to 120 deg. F. by countercurrent exchange with water. The water runs in the jacket and the gas through the inner tube. The unit consists of 16 vertical jacketed hairpin coils, 12 in. tube centers, and about 42 ft. over-all length.

The inner tubes of the unit are 1¼ in. diameter with 8 gage wall thickness, while the jackets are 6 in. diameter, Schedule 40 carbon steel pipe.

The competitive shell and tube unit consists of 54 tubes, 1¼ in. outside diameter, ¾ in. inside diameter, each 50 ft. long. They are spaced on 1¾ in. centers and are enclosed in a 14½ in. inside diameter water shell. There are no baffles or lateral supports for the tubes, the unit being installed vertically. This unit follows commercial German design.

In considering heat exchangers, the radiant type preheater used by the Bureau of Mines is worth noting. The problem involved is to preheat a paste of oil, ground coal, and catalyst from 250 to 815 deg. F. Some hydrogen is added to reduce the viscosity of the paste. Pressure within the unit is 10,300 psi.

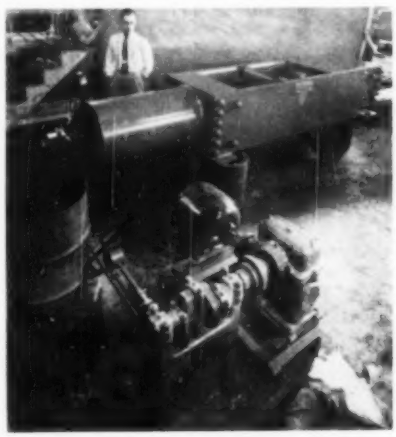
Standard German practice for these preheaters was to build them of finned tubes, with heating by convection rather than radiation. This design gives excellent heat control with little or no danger of overheating and consequent coking inside the tubes. However, application of fins to high pressure tubing is a difficult welding job and the Bureau turned to radiant heating instead.

In designing the radiant preheater, one major problem was that there is a sudden rise in viscosity of the paste at about 600 deg. F. This was solved by adding hot hydrogen and recycle oil to the paste to jump the temperature of the mixture beyond the critical point.

Overheating a problem

Another problem, of more importance to general high pressure design, was to prevent overheating. This was done, first, by putting a steam jacket around the high pressure tubing. Hence, heat flow must go through the jacket, the steam, and the tube before reaching the paste. Furthermore, heat densities were maintained at a low figure, 2,700 Btu. per sq. ft. in the hottest section.

A very common type of cooler or condenser for high pressures is the drip cooler. This type of unit is common as the aftercooler for high pressure compressors and also as the condenser after the converter on ammonia and methanol units.



Use of intensifiers grows as an alternate for . . .

COMPRESSORS FOR HIGH PRESSURE

Use of intensifiers grows

There have been relatively few changes in recent years in compressor and pump design for high pressures. What changes there have been have been primarily modifications of previous designs. The most marked change in methods of reaching high pressures has been the growing use of intensifiers.

There is considerable difference of opinion on the merits of intensifiers versus plunger type compressors. One compressor proponent puts it

this way: "Intensifiers can be used to produce pressures of 2,500 to 3,500 atm., but it seems to me that this method of increasing the pressure is not an economical use of power as the best intensifiers have a mechanical efficiency of 95 percent. This power loss added to the power loss in the compressor furnishing the motive fluid for the intensifier would greatly overbalance an installation using a plunger type compressor to furnish these pressures direct. Also for large volumes of gas, the intensifier would have to be of rather large diameter or a series of smaller intensifiers would have to be used."

Carbide using them

On the other hand, some high pressure users have been turning to intensifiers. Perhaps most notable is Carbide which is using them to reach the 2,000 atm. it uses for producing polyethylene. These units are also notable in that they are double-acting. Here a central cylinder acts both ways, alternately pushing two high pressure cylinders. The units work at about 10 strokes per min.

Another use for intensifiers came about during the war in the autofrettage (see above under Vessels) of gun barrels. Pressures used went as high as 100,000 psi. and the liquid medium was usually glycerine.

Centrifugal types are being tested

The only other new development in the compressor field that seems to bear watching is the German use of centrifugal compressors at very high pressures. They had a reasonably satisfactory unit operating as a circulating compressor on an ammonia unit, running at 350 atm. Probable development along this line will be to enclose the entire motor and compressor within a pressure vessel.

There have been relatively few changes in high pressure pump design. The vertical, single-acting pump still dominates the field. However, there seems to be a growing use of horizontal, double-acting pumps. These units have relatively slow-speed action and are usually steam-driven to get variable output. Such pumps are being used on polyethylene and also by the Bureau of Mines in pumping coal-oil paste.

CLOSURES FOR HIGH PRESSURE

Methods of sealing pressure in a vessel or pipe are one of the most important aspects of high pressure design. Involved are sealing areas from tiny pipe connections to the heads of huge converters. However, because of this importance, a great deal of work was done in the early high pressure days. There has been little change in the techniques used in recent years.

Designs are compromise

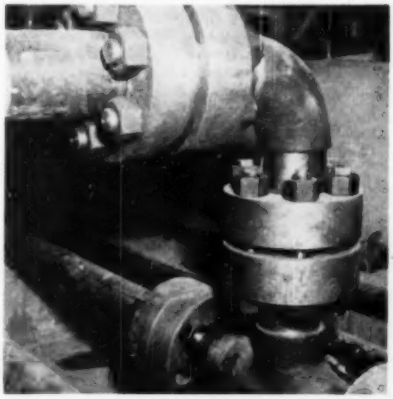
The problem of sealing high pressures has several facets, and the best designs are a compromise by necessity. An ideal closure should tighten up easily (not require sledging of heavy bolt wrenches). It should be light, easy to machine, cheap. It should seal the pressure positively, but it should be easy to open and remove for maintenance. Designing a closure with all these characteristics is not easy.

Perhaps the most interesting development is not new. It has been in use for just ten years this month, but its existence has only recently been made public. That development is the delta or triangular type gasket.

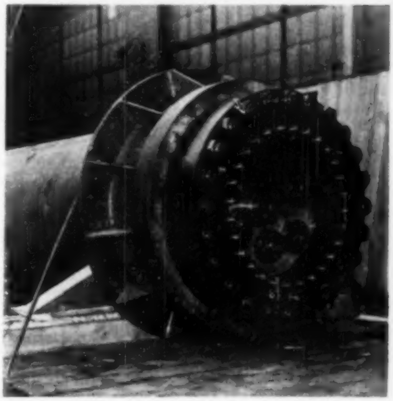
Delta type may be best

The triangular or delta gasket was first developed by Du Pont, starting in 1938. It has been in continuous use at Belle, W. Va., since then, but only in the last year has the gasket been made public. Several vessel manufacturers are now offering the gasket on vessels they design. They are being used extensively by the Bureau of Mines in their demonstration coal hydrogenation plant at Louisiana, Mo., having been specified by Midvale.

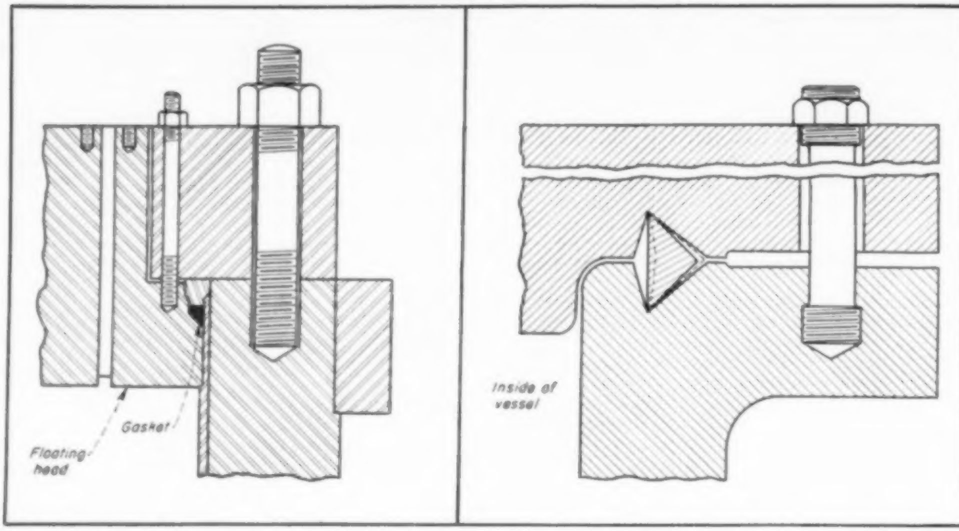
The delta gasket is an "unsupported area" type of gasket. Its seal depends on the pressure inside the vessel, rather than on any external pressure applied by bolting. The method by which it seals is shown in the illustration. The biggest advantages are economy and ease of



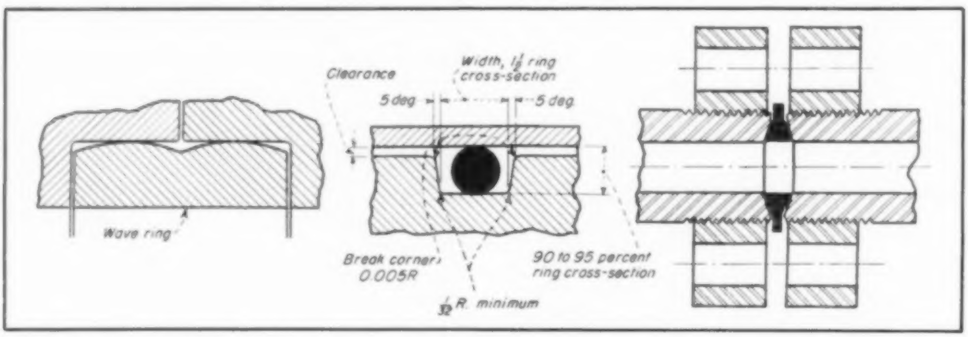
Pipe flanges are often closed by lens rings.



Vessel closures are more complicated, like this.



FOR LARGE HEADS these two types of closures are most popular. There are many variations of the Bridgeman type (left). The delta type (right) was developed by Du Pont ten years ago. It is simple, effective, cheap. Both types are self-sealing.



FOR SMALL HEADS AND PIPING these three gaskets are effective. Wave ring (left) is popular in England. O-ring (center is wartime development, uses synthetic rubber ring. Lens ring (right) is used by Bureau of Mines following German practice.

These five gasket types do most of the H. P. work.

vessel opening—there is no place for the gasket to stick if it is properly designed.

Du Pont experience good

Here is what Du Pont says of its development: "The first application to a large vessel was Aug. 3, 1939. This vessel has been in constant use since the triangular gasket joint was applied and difficulties that were frequently experienced with a flat gasket joint have been entirely eliminated. We have many other applications and in every case the results have been satisfactory even for the highest superpressures which we have attained in some test work. Various metals have been used for the gasket material.

"This joint was developed as an improvement over the lens and wave ring joints and we think it has all the advantages of these two with none of their limitations. While there are a number of high pressure joints based upon the unsupported area principle, the triangular or 'delta' gasket joint seems to be the most simple and foolproof and enables a very economical vessel construction to be used. This means low first cost and low maintenance costs."

Bureau has trouble

The initial experience of the Bureau of Mines with this gasket has not been completely satisfactory. The Bureau's vessels have these gaskets made of SAE-1020 steel with a 0.002 in. copper plating. They are 33.25 in. I.D. and 0.727 in. high. The thickness of the gasket is

0.375 in. The gaskets fit into two grooves, each 0.35 in. deep, one in the vessel wall and the other in the head.

The trouble that the Bureau has experienced involves galling of the gasket and contact surfaces, due apparently to fluctuations in pressure within the vessel. This allows leakage. The Bureau is trying to eliminate this by using thin foil strips at the top and bottom of the gaskets.

Current designs are secret

So far, Du Pont will not give out details on its current gasket design. On the Bureau of Mines units, the same size gasket has been used despite the size of the opening to be sealed. Du Pont will admit that it varies the gasket size with the vessel size, but will not give details. It is possible that this is one of the troubles with the Bureau of Mines' units.

Bridgeman gasket popular

The other popular closure for large units, also illustrated, is a modified Bridgeman closure. Like the delta gasket, it is self sealing. As can be seen in the illustration, the pressure forces the floating head up against a retainer ring, squeezing a somewhat triangular gasket into the space between the floating head and the vessel wall. The seal obtained is excellent. This design has been used on most of the ammonia plants in this country.

There are only two troubles with this type of closure. First, it requires rather precise machining, and a considerable amount of it. This tends to make the initial cost high. Second, the gasket has a tendency to extrude into the space between the wall and head. When it does so, it may cause the head to stick, hence making maintenance more difficult. Various modifications have considerably improved this condition. One such modification is to use a circular gasket (in cross-section) of slightly harder material than the head or wall.

A major advantage to this closure is that it requires no heavy bolting for the head. Hence in restricted areas, where it is difficult to sledge bolts, the closure has a real advantage.

Lens rings used for piping

For smaller closures, such as pipe joints, the lens ring is often used. The Bureau of Mines is using them in its coal hydrogenation plant, following German practice (see illustration). The Bureau cites four reasons for choosing this joint: (1) The gasket seating surface is closer to the center line of the pipe which tends to reduce bolt load and, hence, flange thickness; (2) The joint is essentially self-sealing; (3) The narrow contact width, due to the two spherical surfaces, gives high seating pressures; (4) Perfect alignment is not necessary.

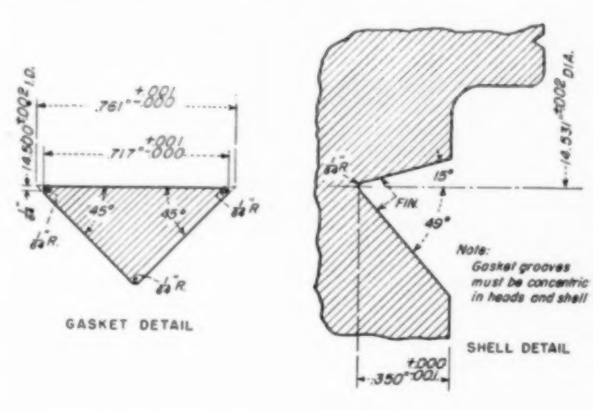
In all cases, the Bureau has used a ring material not quite as hard as the flange material. For larger pipe sizes (1 in. diameter and greater) a bellows type lens ring has been used (not in the illustration). The ring is made hollow and the full inside pressure gets inside the ring, tending to give even greater sealing pressure. The bellows type is also claimed to give better flexibility when dealing with high temperatures.

Use on big vessels debatable

Lens rings have also been used for vessel closures, and other places where larger rings are required than on normal piping. One authority has used them in sizes up to 24 in. with excellent results. Others tend to feel this is too large for satisfactory, economical results. The one problem with lens rings is that they require careful machining of both the rings and the flanges. This tends to make the design high cost.

The wave ring is another type of closure which has been used in pipe joints, particularly in England. The ring is made of a material that is harder than the flange or vessel. It is self-sealing. This joint has never become popular in the United States. At least one authority

Many feel delta type is simplest, cheapest, best.



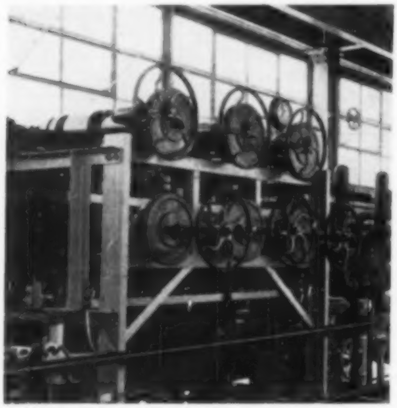
DESIGN DATA shown here is for the original delta gasket installed by Du Pont ten years ago this month. It is probable that new Du Pont designs are somewhat different, but this particular design has been in use ever since it was installed and has been completely satisfactory. The machining required is not too intricate. Hence the closure is inexpensive. The vessel involved was a separator on an ammonia unit. The gasket was made of SAE-1035 steel, annealed. Design working pressure was 12,500 psi.

says, "I do not think that the wave ring joint is very practical, at least for commercial plant work."

O-Ring looks good

One other joint that might be mentioned is the O-ring (*Product Engineering*, July 1947, pp. 163-166). This development is rather new and stems primarily from work done on aircraft during World War II. In this seal (see illustration) the gasket is a synthetic rubber ring, which is retained in a groove in one of the two faces to be sealed. It is claimed that this joint has sealed pressures as high as 20,000 psi., even under extreme vibration and repeated impulsing. Leather back-up rings can also be used. Synthetic rubbers are available that make this joint satisfactory at temperatures as high as 250 deg. F.

There are literally hundreds of other closure designs, far more than can be considered in this report. Most of them are slight modifications of the above, or have proved impractical or uneconomic in commercial work.



Heavy, bulky looks are apparent in . . .

VALVES FOR HIGH PRESSURE

One of the major problems that faces the high pressure designer is to find satisfactory valves. At pressures below 5,000 psi., this is fairly easy since designs can follow ASA standards and are generally available from stock. It is in the higher pressures that standard designs are not available. There are a number of companies, however, which will design and produce such valves.

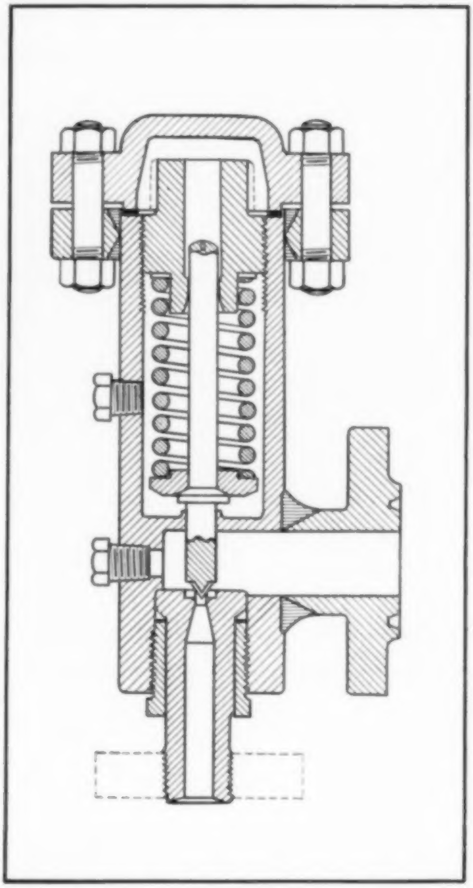
Valves are not standard

The biggest problem among the valve manufacturers has been a reluctance on the part of users to get together on a single design. Du Pont, Carbide, Chemical Construction, and so forth, all have different valve designs and specifications. This means that almost every job is a special one—and high cost.

There are two ways in which a discussion of valves may be divided, by pressure and by use.

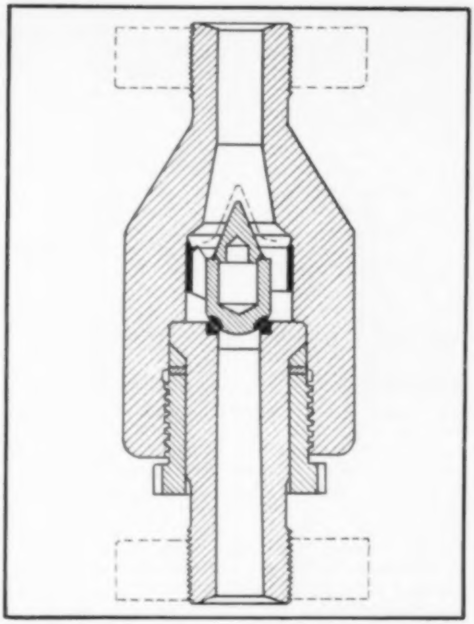
In pressure, there is a definite dividing line that falls between 2,500 and 5,000 psi. At the lower pressures, valves are made from steel castings, have integral flanges, are either globe or angle construction. They retain pressure in the body by means of a gasket between bonnets and blind heads and body, have screwed-in replaceable seats. In these lower pressure valves most companies will accept a standard design.

From 5,000 psi. up, special valves are required. The higher pressure valves are made from solid

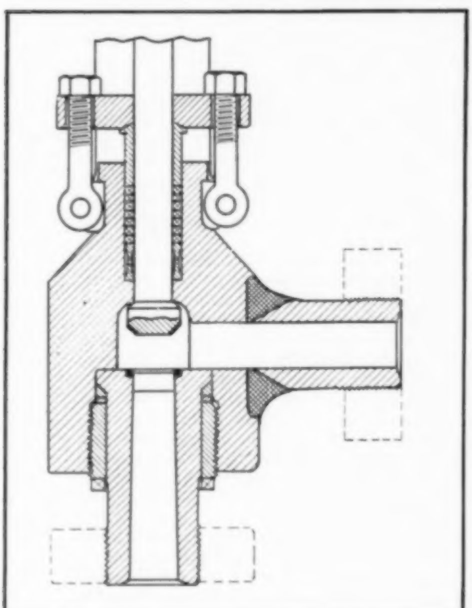


RELIEF VALVES are spring-loaded with Stellite faced seat, designed for 10,900 psi., 300 deg. F.

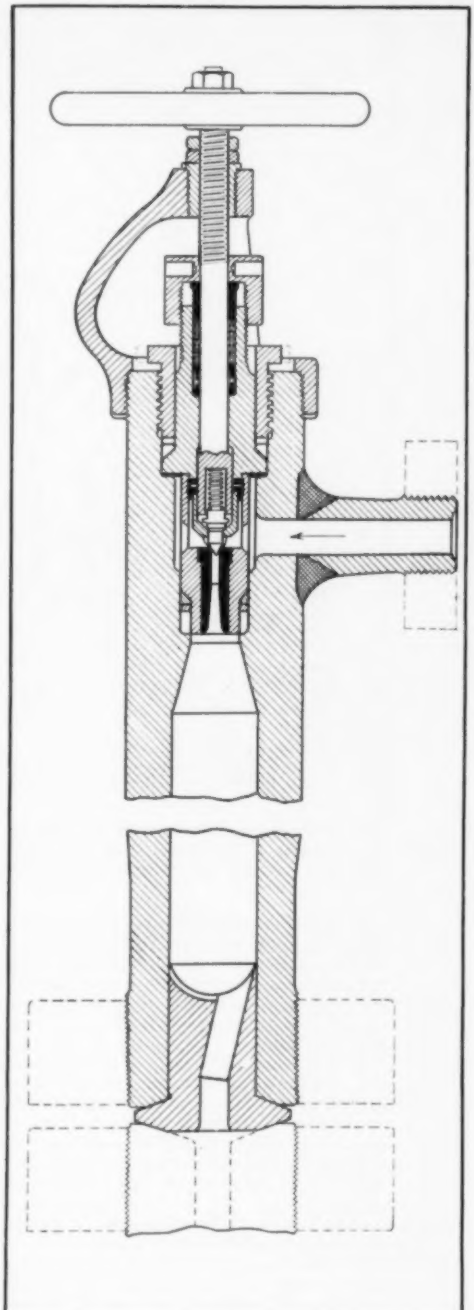
These are the Bureau of Mines designs for the four main valve types



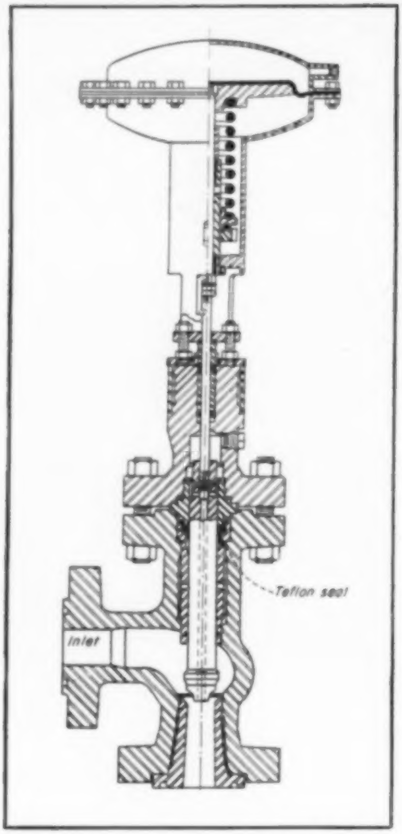
CHECK VALVES have tear-drop shaped, hollow disk of Stellite guided by three Stellite vanes.



SHUT-OFF VALVES also have Stellite inserts, have removable seats, are self-sealing in operation.



THROTTLING VALVES take beating, have removable Stellite target plate, Kennametal outlet nozzle.



Teflon packing in this Hammel-Dahl valve means easier stem movement for automatic control.

forgings, and are almost always of angle construction to eliminate one joint. They retain pressure by using a bonnet of the pressure sealed type, using the pressure within the valve to achieve the seal. Threaded-on flanges are used. Seats are not threaded on but are held in place by the bolting of line flanges.

High pressure valves can also be classified by use. The Bureau of Mines considers four classes: shut-off valves, check valves, throttling valves, and relief valves. Examples of all four of these types of valves are illustrated. The designs are fairly conventional and presented no particular problems, except for the high pressure throttling valve.

Throttling valves a problem

The throttling valve illustrated lets down a slurry of hot material from 10,000 to 100 psi. The material going through the valve consists of the viscous oil from the first stage of hydrogenation, the suspended solid catalyst particles, and adsorbed gases. As the mixture passes through the valve, the adsorbed gases desorb and expand some 700 times—increasing velocity and giving an extremely abrasive effect within the valve. The Bureau of Mines describes the valve as follows:

"The severe throttling valve is built in two forms: hand operated or automatic diaphragm type. In construction it is similar to the German 'Patronenventil' or cartridge valve. As the name indicates the target plate is removable, somewhat like a rifle cartridge. Parts subjected to severe abrasion are made of hardened material: Kennametal disk and seat insert, Exelloy disk holder hardened to 400 Brinell, and Stellite-lined target plate. The removable cartridge disk is attached to the bottom of the valve stem by the screwed-on disk holder, and is backed up by a chrome-vanadium steel spring to protect the brittle Kennametal tip and seat from damage by excessive pressure applied to the stem. The lock nuts on the stem above the yoke bushing serve a similar purpose. The Kennametal outlet nozzle, forming the seat, is of the venturi-type to minimize cavitation or erosion at high velocities. The outlet nozzle discharges into an expansion chamber, the removable bottom of which, called 'target plate,' is made integral with the outlet flange lens gasket. The jet from the outlet nozzle impinges upon the Stellite-lined, concave spherical surface of the target, and is discharged through the target outlet, drilled eccentrically to the target face. Most of the gas entrained in the liquid is liberated in this expansion chamber and eventually separated from it in the let-down vessel, or receiver."

Removable targets help

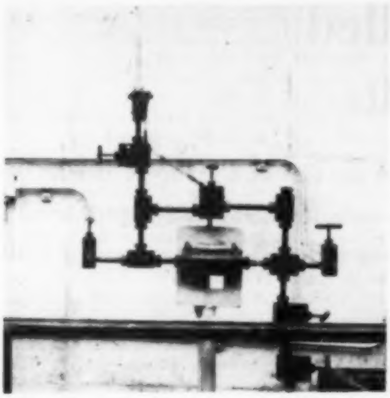
Also illustrated is a shut-off or flow control valve produced by the Hammel-Dahl Co. The thing that is different about these valves is that they replace a conventional gasket with a plastic seal.

In valves where conventional packing boxes are used, stem friction is relatively high. This means that diaphragm operation has been limited, in general, to "on-off" control, rather than automatic flow control from "on" to "off." The plastic seal, made of Teflon, cuts stem friction drastically, even at pressures as high as 22,000 psi. This fact makes possible the application of air operated industrial instruments and diaphragm control valves for throttling action and continuous operation.

Teflon seal is one solution

Use of Teflon in the seal also means a material that is completely inert to the chemicals that may be used, is self-lubricating, and can stand a high temperature. With cooling applied to the seal, there should be no temperature limitation for the valves due to this type of seal. This type of seal has been in use for more than three years with no failures.

This type of seal is one of the few major advances in valve design in the past few years. As one authority puts it: "There have been no major fundamental changes in high pressure valve design in the past ten years. All designs accomplish their result by means of brute strength and awkwardness. Most of the valves look clumsy, large and awkward in relation to line size. With the advent of higher strength alloys, it may be possible to reduce the size of valves relative to line size and capacity and produce valves in better mechanical proportion." But whether designs can be standardized for different companies is an open question.



Statham flow gages are a new development in . . .

INSTRUMENTATION FOR HIGH PRESSURE

Instrumentation for high pressure operation has had considerable recent development.

Flow control a problem Flow control at high pressure is still somewhat of a problem although the situation is much improved. One major problem was that of turning high pressure valves and having them hold at intermediate positions. Under the discussion of valves, above, it was pointed out that this has been solved at least partially by the use of Teflon packing. The major problem today revolves around pressure measurement by which pressure drop can be accurately measured. Given this, the conventional flow controllers will do the job.

Most pressure measurements are still handled by Bourdon tubes, which have an accuracy of two to three percent. For normal checking of operating pressure such an accuracy is sufficient, but when dealing with differential pressures over an orifice it is none too good.

Among the other methods, the most common is a high pressure mercury tube manometer. A float on the mercury, is attached by a vertical rod to an armature in an inductance coil. Vertical movement of the armature causes a change in electrical conditions which can control flow.

Statham elements new: may do trick A new development in flow measurement is the Statham element. This unit operates on the principle that stretching or compressing a wire causes changes in its electrical resistance and that such a change can be a measure of the force acting on the wire. For flow measurement the differential pressure across the orifice plate is connected to the element in such a way that a force in one direction is created on four wires in the element. The wires are arranged so that two tend to be stretched by the force while the other two are compressed. Thus an appreciable resistance change is created which can be measured by a potentiometer. This unit, still experimental, promises relatively economic yet highly accurate flow measurement.

Liquid level control is another variable whose measurement has been a problem. With low pressure operation, a measurement of pressure differential at various levels will do the job. But just as in flow control, the pressure measurement has to be accurate because the differential is a very small percentage of the total pressure.

Radium finds liquid level Another approach to this problem is being tested by the Bureau of Mines in their high pressure separators. This unit, a Gagetron, comprises a small quantity of radium located at the lower liquid level. Above the top liquid level is a Geiger-Mueller counter which measures the output of gamma rays from the radium. There is enough difference in the gamma ray absorption between the oil and the vapors to accurately determine the liquid height.

CONCLUSION

Such, then, are the recent developments in high pressure processing. It may seem trite to say there will be further development along high pressure lines. But all chemical processing is reaching out toward the extremes—high temperature, low temperature, high vacuum, high pressure. High pressure was perhaps the first of these extreme conditions the chemical engineer tackled. There are still many things to be done with high pressure, and the know-how and technology are already available. For that reason, if for no other, high pressure processing seems destined for an ever more important role in the chemical process industries.

Thanks Finally, we would like to acknowledge the assistance of those persons in the chemical process industries, and those who supply equipment for those industries, in preparing this report. Among those who contributed materially were H. J. Bartlett, Crane Co.; C. O. Brown, consultant; T. H. Chilton, Du Pont Co.; Axel Christensen, Chemical Construction Corp.; E. W. Comings, University of Illinois; Walter Coopey, Du Pont Co.; W. L. DeLaney, Baldwin Locomotive Works; B. F. Dodge, Yale University; J. T. Donovan, Bureau of Mines; L. L. Hirst, Bureau of Mines; Bruce A. Irvin, Hammel-Dahl Co.; J. A. Markovitz, Bureau of Mines; H. H. Needham, A. O. Smith Corp.; P. G. Reynolds; Du Pont Co.; E. S. Roberts, Chemical Construction Co.; B. C. Thiel, Cooper-Bessemer Corp.; C. A. Vill, Chemical Construction Corp.; V. W. Weiler, A. O. Smith Corp.; and H. H. Ziesing, Midvale Co.

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Design of Thick-Walled Pressure Vessel Shells

This is the first of a group of articles discussing design of thick-walled vessels for high pressures. Those to follow will deal with pre-stressed vessel shells

R. R. MACCARY and R. F. FEY

An increasing trend toward higher pressures in many processing operations is demanding a more practical approach in the design of thick-walled pressure vessels. A knowledge of the design criteria is essential on the part of both the process engineer and the designer, if economies in construction are to be evaluated with respect to process requirements.

When the thickness of a vessel shell is increased to withstand higher pressures, the basic assumption of uniformly distributed tensile stresses across the shell thickness (in accordance with the membrane theory) is no longer valid. Instead of the general membrane formula, we require formulas specially suited to thick-walled pressure vessels.

From a practical point of view, a knowledge of the limits of applicability of the membrane formula and the thick-walled vessel formula is essential in preventing possible errors of misapplication. An examination of the assumptions underlying the most widely accepted formulas for thick-walled vessels offers a foundation for ascertaining their limitations.

Of the many formulas that have been proposed to express the relation of pressure and stress in thick-walled cylinders, the well-known equations of Lamé give satisfactory results when properly interpreted within the limits of applicability. There are two principal stresses produced in the wall of the vessel, a radial stress and a tangential stress. Referring to Fig. 1, in which P_1 and P_2 are respectively the internal and external unit pressures and R_1 and R_2 the corresponding radii, the Lamé analysis gives the following formulas:

$$S_r = A - B/r^2 \tag{1}$$

$$S_t = A + B/r^2 \tag{2}$$

Here S_r is the radial compressive stress on a cylindrical surface of radius r, and S_t is the tangential stress which may be either tensile or compressive, depending on the relative magnitudes of internal and external pressure. A and B are constants whose values are:

$$A = (P_1 R_1^2 - P_2 R_2^2)/(R_2^2 - R_1^2)$$

$$B = (P_1 - P_2) R_1^2 R_2^2/(R_2^2 - R_1^2)$$

In the majority of cases, the external pressure is merely that of the atmosphere which may be considered relatively insignificant in comparison with high internal pressures. Equations (1) and (2) then reduce to

$$S_r = \frac{P_1 R_1^2}{R_2^2 - R_1^2}\left(\frac{R_2^2}{r^2} - 1\right) \tag{3}$$

$$S_t = \frac{P_1 R_1^2}{R_2^2 - R_1^2}\left(\frac{R_2^2}{r^2} + 1\right) \tag{4}$$

These equations, whose derivation is considered as the solution of a two dimensional stress problem by Timoshenko, give compressive stresses for S_r and tensile stresses for S_t. The maximum stress is the tensile stress at the inner surface of the cylinder, which furnishes the basis of design for thick-walled pressure vessels, as in Eq. (5):

$$S_t = P_1 \frac{R_1^2 + R_2^2}{R_2^2 - R_1^2} \tag{5}$$

To apply this formula intelligently it is worth while to review the basic assumptions of its derivation. The origin and fundamental background of the Lamé formula have been critically examined by Comstock,[2] while tests described by Norris[3] furnish experimental verification of the formula.

It is assumed that the conditions of loading produce a state of plane strain, that is, cross sections of the cylinder remain plane under stress. The presence of longitudinal tension transmitted by the heads of the vessel to the cross-section of the shell leads to an inconsistency. However, longitudinal stress is never a governing factor and may be disregarded from the practical viewpoint.

A review of the formula for longitudinal stress demonstrates that such stress is always less than one-half the value of the maximum tangential stress. The longitudinal stress S_l is:

$$S_l = P_1 \frac{R_1^2}{R_2^2 - R_1^2} \tag{6}$$

and the ratio of longitudinal stress to the tangential stress becomes:

$$\frac{S_l}{S_t} = \frac{R_1^2}{R_1^2 + R_2^2} \tag{7}$$

which indicates that the denominator will always be greater than twice the inside radius.

The assumption of plane strain may be considered substantially correct for a cylinder of finite length, with the exception of the ends where discontinuity and effects are caused by constraint due to the heads or other method of closure. From practical considerations, only relatively short cylinders may be considered to depart from the condition of plane strain. Cylinders approximately three to four diameters long may be safely considered as the lower limit in the application of the Lamé formula. The design of shorter vessels will demand special analysis.

A further assumption is the understanding that the material is isotropic and is free from initial stress. Freedom from initial stress in a fully isotropic material is not entirely realizable even in steel, but the present state of the art in fabrication of pressure vessels produces structures which approach such conditions. The use of the Lamé formula is justifiable in monobloc shells, since the variations from the assumed conditions are well within the limitations provided by the use of a safety factor in design.

Since the formula is based on the theory of elasticity, its

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use is valid only within the limits of the linear relationship between stress and strain. The Lamé formula may, therefore, be used to calculate stresses only when the stresses remain within the elastic limit of the material. It cannot serve to calculate the ultimate strength of a shell. The laws of stress distribution beyond the elastic limit of the material diverge widely from those based on linear relationship between stress and strain.

Membrane Formula

A comparison of the membrane shell formula and the Lamé formula presents a criterion for ascertaining the range of applicability of the two formulas and their divergence.

Resolving the membrane formula into the same terms as the Lamé equation, with the shell thickness $t = R_2 - R_1$:

$$S_t = P_1 \frac{R_1}{R_2 - R_1} \tag{8}$$

which may be compared directly with Lamé equation:

$$S_t = P_1 \frac{R_1^2 + R_2^2}{R_2^2 - R_1^2} \tag{5}$$

For any given pressure, these formulas indicate that the stresses will vary as follows, when $K = R_2/R_1$:

For the membrane formula

$$S_t \propto 1/(K - 1)$$

For the Lamé formula

$$S_t \propto (K^2 + 1)/(K^2 - 1)$$

A study of Fig. 2 reveals the divergence between these two formulas in calculating stresses in cylinders. It is interesting to note that the difference between the two formulas is insignificant for lower values of R_2/R_1, justifying the use of the simpler membrane formula in these cases.

Expressing the membrane formula and the Lamé equation in terms of the ratio t/D_1, where t is the shell thickness and D_1 is the inside diameter, the percentage difference between the two formulas for any ratio of t/D_1 is:

Membrane formula

$$P_1 = 2\,S_w\,(t/D_1) \tag{9}$$

Lamé formula

$$P_1 = S_w \frac{(t/D_1)^2 + (t/D_1)}{(t/D_1)^2 + (t/D_1) + 1/2} \tag{10}$$

where S_w is the allowable working stress of the material. Fig. 3 shows the percentage difference between the two formulas, based on the use of a material with an allowable working stress of 13,750 psi.

Pressure vessel codes[4] have limited the use of the membrane formula to shells whose thickness is less than 10 percent of the diameter. For a thickness of shell greater than 10 percent of the diameter, the use of the Lamé formula becomes mandatory. Fig. 3 indicates that for $t/D_1 = 0.1$, the allowable working pressure of a vessel (with an allowable working stress equal to 13,750 psi.) will be in error by approximately 10 percent through use of the membrane formula, as compared with the correct value computed by Lamé formula.

Evidently, an error of 10 percent can be considered the upper limit for the use of the membrane formula, since such variation is acceptable for most practical applications. The use of Fig. 3 can then serve as a guide in the selection of the proper formula for designing a cylindrical shell within the desired degree of accuracy. For materials with different allowable working stresses, the percentage error will vary slightly, but may be computed if necessary.

The ASME Pressure Vessel Code[5] does not limit the use of Lamé equation to vessels with t/D_1 greater than 0.1 but, instead, sets this limit at t/D_1 greater than 0.25. A modification of the membrane formula is employed which

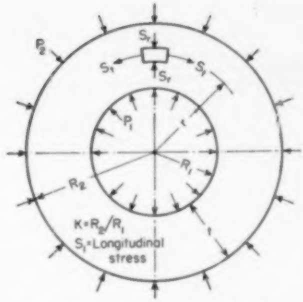

Fig. 1—Vessel cross-section defining terms used in stress analysis.

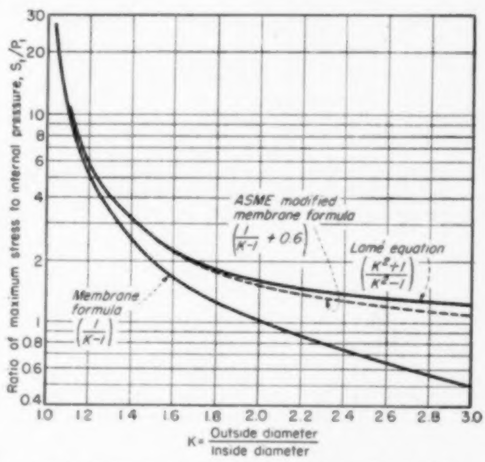

Fig. 2—Divergence of maximum tangential stresses in cylinders as calculated by Lamé, membrane and ASME modified membrane formulas.

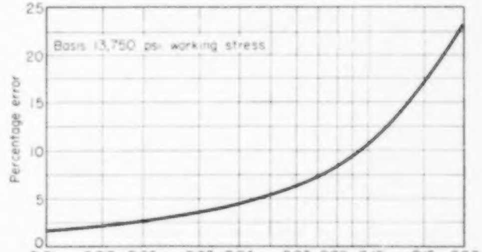

Fig. 3—Percentage error in membrane formula assuming Lamé formula to be correct.

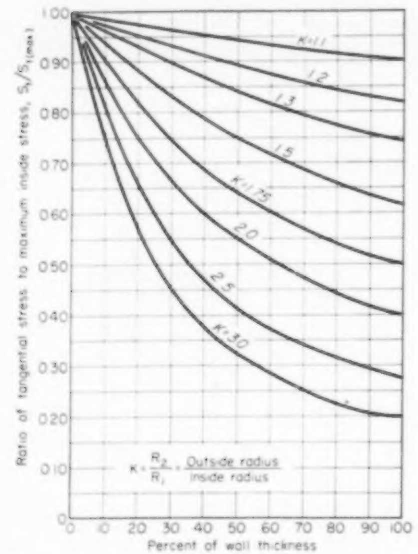

Fig. 4a—Ratio of tangential to maximum inside stress for various values of K and various percentages of the wall thickness.

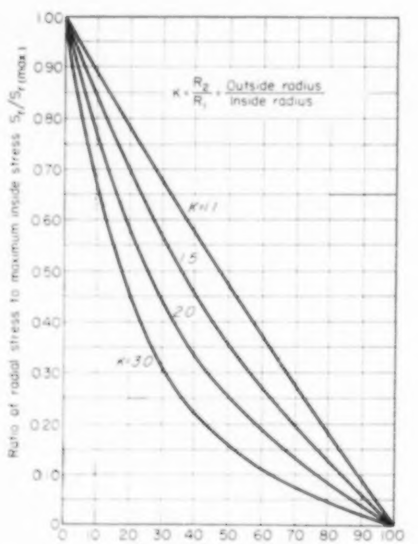

Fig. 4b—Ratio of radial stress to maximum inside stress for various values of K and various percentages of the wall thickness.

reveals that an additional factor has been added that not only eliminates the marked difference in thickness in passing from the membrane formula to the Lamé formula, but also permits extension of the limit of applicability of the membrane formula to $t/D_1 = 0.25$ instead of $t/D_1 = 0.10$. Such a modification of the membrane formula permits its use for calculating thick-walled cylinders up to the limit of $t/D_1 = 0.25$, with a maximum error of approximately 1 percent on safe side at this limit. Fig. 2 shows how closely the modified formula follows the Lamé equation.

Investigating the stress distribution across the thickness of the wall of a cylinder reveals that the greater part of the material is not subject to the permissable working stress. From Eq. (4) the ratio of the tangential stress at a radius r of the cylinder to that at the inside of the cylinder is

$$\frac{S_{t1}}{S_{t\,max.}} = \frac{(R_2^2/r^2) + 1}{(R_2^2/R_1^2) + 1} \tag{11}$$

where S_{t1} is the tangential stress in the cylinder wall at the radius r under consideration.

Similarly, the ratio of the radial stresses may be expressed from Eq. (3)

$$\frac{S_{r1}}{S_{r\,max.}} = \frac{(R_2^2/r^2) - 1}{(R_2^2/R_1^2) - 1} \tag{12}$$

where S_{r1} is the radial stress in the cylinder wall at radius r. Figs. 4 *a* and *b* give a comparison of the variations of stresses from the inside to the outside of the cylinder. These curves may be used to compute the stress at any point within the cylinder wall, as well as the outside stress for any given value of r/R_1 when the stresses on the inside of the cylinder have been calculated.

The Lamé equation of tangential stress on the inside of a cylinder may be expressed in terms of the ratio t/D_1, which enables it to be put into graphical form for convenient use in design. Modifying Eq. (10):

$$P_1 = S_w \frac{K_1^2 + K_1}{K_1^2 + K_1 + 1/2} \tag{13}$$

where $K_1 = t/D_1$, the radio of thickness of wall to inside diameter, and S_w is the allowable working stress of the material. Fig. 5 is a design chart which may be used in the determination of wall thickness for a range of working stresses normally employed with the more common materials of construction. If the cylinder is of welded design, the working stress is the product of allowable design stress and weld joint efficiency, $S_w = S \times E$.

In a general application the membrane formula considers bi-axial stresses in a plane normal to the applied pressure. In applying the formula in determining the tangential stress in a cylinder, it may be considered as a uni-axial or simple ring stress.

The Lamé formula, however, considers stresses in a cylindrical shell as bi-axial, in a plane parallel to the applied pressure. Both radial and tangential stresses are considered.

Theories of strength which are general in application and have received considerable experimental verification are very completely discussed by Nadai[8]. The combination of the radial, tangential and axial stresses in a closed cylinder subjected to internal pressure (a tri-axial system) can furnish a more accurate criterion of the state of stress and design, where a more critical investigation is needed.

With sufficient accuracy for practical purposes, the combination of stresses in accordance with the theory of maximum energy of distortion offers the closest approximation to actual test data until a better knowledge is gained of the general physical laws of behavior of metal under the action of combined stresses. The maximum energy of distortion theory of von Mises-Hencky represents the condition of yielding as:

$$(S_t - S_r)^2 + (S_r - S_l)^2 + (S_l - S_t)^2 = 2\,(S_{y.p.})^2 = \text{Constant} \quad (14)$$

where $S_{y.p.}$ is the yield stress for pure tension in the material. The yield point stress may be substituted by the allowable working stress S_w to arrive at a suitable relation in combining stresses on the basis of design conditions. Therefore:

$$(S_t - S_r)^2 + (S_r - S_l)^2 + (S_l - S_t)^2 = 2\,(S_w)^2 \quad (15)$$

The maximum stresses on the inside of the cylinder, which are the ones it is desired to combine, may each be expressed as a function of P/t and R_2 and R_1.

Radial stress (compressive)

$$S_r = -\,(P/t)\,(R_2 - R_1) \quad (16)$$

Tangential stress (tensile)

$$S_t = (P/t)\,\frac{R_1^2 + R_2^2}{R_1 + R_2} \quad (17)$$

Axial stress (tensile)

$$S_l = (P/t)\,\frac{R_1^2}{R_1 + R_2} \quad (18)$$

Combining the three stresses in accordance with the relation of Eq. (15), the allowable working pressure P is:

$$P = 2.31\,S_w\,(t/D_2)\,(1 - t/D_2) \quad (19)$$

where D_2 is the outside diameter of cylinder. This formula can be used as the basis of design in cases where the effects of combined stresses must be taken into consideration. It may also be expressed as:

$$P = 2.31\,S_w\,\frac{K_1^2 + K_1}{(1 + 2\,K_1)^2} \quad (20)$$

where $K_1 = t/D_1$. The maximum energy of distortion theory may be compared with the Lamé equation by comparing the two design charts, Figs. 5 and 6.

When the factor of safety is low, that is, where the design stress approaches the yield stress, the use of the maximum energy of distortion theory is recommended for thick-walled vessels.

When the ratio of outside diameter to inside diameter equals or is greater than 1.2 in thick-walled pressure vessels, and where the vessel is subjected to steady temperature and pressure conditions, the Lamé or code-modified membrane theory is recommended for determining the shell thickness. When the vessel is subject to cyclic conditions of varying pressure and temperature at regular or frequent intervals, the use of the distortion-energy theory is indicated.

In many designs of thick-walled cylinders, a knowledge of the magnitude of the change in dimensions of the vessels is pertinent where a more critical analysis is desired. For a condition of uniform internal pressure in a closed-end cylinder, the change in inside radius becomes

$$\Delta R_1 = P\,\frac{R_1}{E}\left[\frac{R_2^2 + R_1^2}{R_2^2 - R_1^2} - \mu\left(\frac{R_1^2}{R_2^2 - R_1^2} - 1\right)\right] \quad (21)$$

while the change in the outside radius is

$$\Delta R_2 = P\,\frac{R_2}{E}\left[\frac{R_1^2}{R_2^2 - R_1^2}\,(2 - \mu)\right] \quad (22)$$

where μ is Poisson's ratio and E is the modulus of elasticity of the material.

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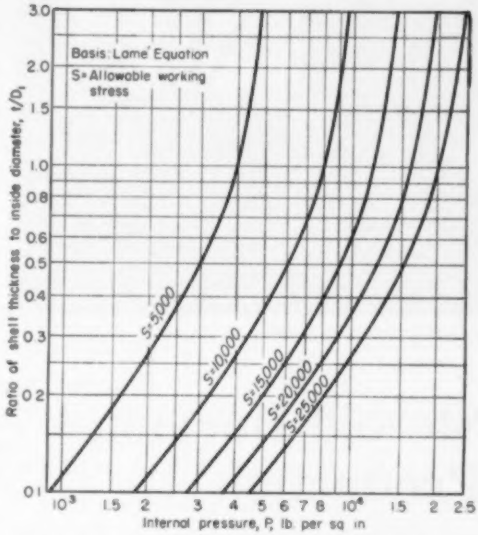


Fig. 5—Design chart for wall thickness of cylindrical shell under internal pressure based on Lamé equation.

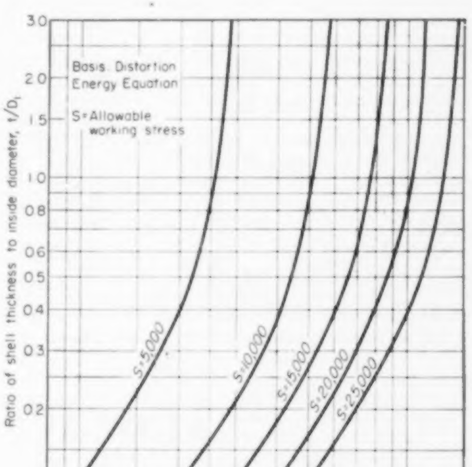
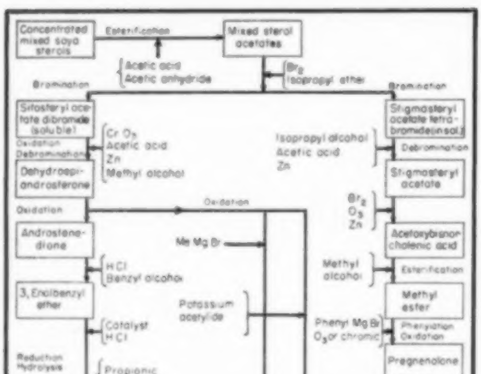


Fig. 6—Design chart for wall thickness of cylindrical shell under internal pressure based on distortion energy equation.

Glass-lined stills are jack-of-all-trades in hormone business.

Steroid Hormone Production . . .



Process uses batch methods, requires very flexible equipment.

. . . How It's Done Commercially

A virile young industry where success depends on ingenuity in micro-production techniques

JOHN R. CALLAHAM

The manufacture of steroid hormones was once largely a German franchise although a few firms were active in this country. About 1947, the alien-controlled patents and techniques were made readily available in the United States. With several domestic producers now in the field, this unusual industry is spurting ahead.

What lessons can chemical engineers learn from the steroid hormone industry? These look most important: (1) flexibility of equipment, as in most low-poundage, fine chemical lines, often spells the difference between success and failure; (2) labor costs—75 percent or more of the total—should never be neglected; (3) micro-production techniques, which are seldom cut-and-dried, call for unusual engineering ingenuity and balance. In more ways than one, it's as tough to design and operate a $100,000 unit to make hormones as a $10,000,000 plant to refine petroleum.

Most important steroid hormones now in use are progesterone, testosterone, ethinyl estradiol, estradiol benzoate, estradiol, pregneninolone, testosterone propionate, methyl testosterone, estrone and desoxycorticosterone. Progesterone is the active ingredient in pharmaceuticals used to treat dysmenorrhea and to prevent habitual abortion; testosterone is the male sex hormone that is also used in the relief treatment of cancer in women. All the products are rapidly being put to new uses in the pharmaceutical field. Their usefulness, say some persons, has hardly been scratched.

This article deals briefly with the engineering and how-it's-done angles of making steroid hormones commercially; it centers around the new plant of Sterol Derivatives, Inc., in Los Angeles. You won't find much about the chemistry (and less about the theory) of hormones in it. If you're interested in these, there are only two good references: (1) FIAT Final Report 996, put out in January 1947, by the Office of Military Government for Germany; (2) the recent 3rd edition of Fieser & Fieser's "Natural Products Related to Phenanthrene" (Reinhold).

THE CASE OF ONE COMPANY

Sterol Derivatives, Inc., of Los Angeles, is the latest firm in this country to go into the commercial manufacture of steroid hormones. The company is now putting into operation a unit to produce progesterone, testosterone and related products (see chart). It is the West's only producer of these low-unitage, high-cost organic chemicals. Monthly output is now about 3-4 kilos of progesterone and 1.5-2 kilos of testosterone.

The Los Angeles operations are batchwise. All equipment has been designed for maximum flexibility to produce hormones as well as synthetic aromatics. Executives of the firm say flexibility is the most important factor in the economic success of the operation. Since the process, from raw material to hormone product, takes about 30 days, some equipment has to be used for a dozen different operations. But it is this laboratory-type flexibility carried over into commercial practice that has helped to make possible the drastic price reductions for progesterone: from $30 a gram five years ago to $2.25 a gram now.

One unusual feature in the processing of steroid hormones is the inverted telescoping effect: about 100 units of raw material to make one unit of combined products. For a monthly output of 4-6 kilos, some 4,000-6,000 kilos of concentrated mixed sterols must be processed. That's why it is logical to start the processing in 200-gal. reactors and to wind it up in glassware.

"One item we really have to watch," admits President

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S. S. Carlat, "is labor costs—which normally add up to 75 percent or more of the total costs of our products. Labor and overhead, in fact, make up about 90 percent of our cost of manufacture; raw materials, chemical reactants and all other items are almost negligible in comparison."

Raw material for making the steroid hormones is not animal glands—but the low-cost foots from soybean oil refining. This comes to the Los Angeles plant as a concentrate of 95 percent or more of mixed sterols. It has about 15-16 percent stigmasterol (starting point for progesterone), some 70 percent beta- and gamma-sitosterol (starting point for testosterone), and about 7-8 percent of other unsaturated sterols.

Reactions in the early stages of the process are carried out in a 200-gal. glass-lined vessel with mechanical agitation, water-cooled jacket, and Pyrex glass reflux condenser. Glass-lined equipment and sanitary dairy-type steel tubing are used throughout. Stainless steel could be used in some steps (such as acetylation and chromic acid oxidation) but glass is the only material of construction that will stand up under all the process conditions; for maximum flexibility it is the only material used in reactors.

Glass separatory funnels on the bottoms of all reactors have one big advantage: they make separations with the clean-cut precision of laboratory technique. Practically all early-stage filtering is done in a 100-gal. ceramic Nutsch filter. A 100-gal. glass-lined still is equipped for refluxing or for distillation at atmospheric or reduced pressures.

Why fight gravity if your plant vapors are heavier than air, asked Sterol engineers? They installed a heating and ventilating system that gives a complete downdraft change of air every six minutes. This system makes it safe to use suspended open fluorescent lights above the 10-ft. level; explosion-proof wiring is used below that level. Carlat estimates that this reversed ventilation scheme cut at least $10,000 off the cost of wiring and lighting the plant.

PROGESTERONE

Here, briefly, is how Sterol makes progesterone and testosterone (the flowsheet will help you to follow the steps). The basic raw material—concentrated mixed sterols from soybean oil foots—is refluxed with acetic acid and acetic anhydride for about two hours. The mixed sterol acetates are cooled slowly; otherwise, filtering troubles will develop later. The acetates are dissolved in isopropyl ether, then brominated by adding Br_2 in acetic acid.

This bromination gives two basic compounds: (1) soluble sitosteryl acetate dibromide (SAD) which gives rise to testosterone and its derivatives; (2) insoluble stigmasteryl acetate tetrabromide (SATB) which is used to make progesterone.

SATB is filtered off on a Nutsch, washed with ether and then dried in a vacuum shelf dryer at about 50 deg. C. It is debrominated in the still by adding isopropyl alcohol, acetic acid and zinc; the product is stigmasteryl acetate (StA). The reaction is heterogeneous and some H_2 comes off. The mixture is warmed and refluxed; care must be taken to insure complete debromination.

StA is dissolved in carbon tetrachloride; bromine equivalent to one double-bond demand is added. This insures that bromination will take place almost exclusively at the 5-6 position on the molecule. Ozone is then bubbled through the liquid at a controlled rate for about 16 hr. A five-fold excess of O_3 is used. This reaction is carried out in batteries of ten 20-l flasks. Ozone is fed into the system through stainless steel piping.

Ozone is generated in a Welsbach unit by passing a 15,000-volt discharge through specially dried or aviator's breathing oxygen that is fed automatically at controlled pressures into the generator from a battery of cylinders. The ozonizer operates at 8 lb. pressure and can produce 100 g. of O_3 per hr. It is fully automatic and has two safety features: (1) a thermal cut-off mechanism that stops the unit if the supply or temperature of the cooling water goes outside the range of safety; (2) a pressure cut-off mechanism that stops it if the operating pressure varies 1 lb. below normal.

The oxidized StA molecule is put through a zinc debromination in the presence of ether and acetic acid; the result is acetoxybisnorcholenic acid (ABNC). This is esterified with methyl alcohol. The ester is put through the paces of the Barbier-Wieland degradation reaction with phenyl magnesium bromide. Pregnenolone is formed by oxidizing with O_3 or chromic acid.

Another oxidation, this time with CrO_3, gives the final product—solid progesterone of USP grade. Over-all yield of progesterone from ABNC is about 25 percent. The tail end of the process—about 30 days away in time from the beginning—is now carried out on a laboratory scale that is being stepped up gradually. Monthly output of progesterone is about 3-4 kilos.

TESTOSTERONE

This hormone is made from the sitosterol sterols in the concentrated soybean oil foots. Soluble sitosteryl acetate dibromide (SAD) is formed and separated, as already described, from the insoluble stigmasteryl acetate tetrabromide.

SAD is first put through what Sterol chemists call the "sledge-hammer reaction." The object: to oxidize the molecule in the one hoped-for position rather than in the 28 possible ones. The conditions: in 200-gal. agitated reactors at 18 deg. C. for 24 hr. in the presence of acetic acid and CrO_3. The yields (after debromination and precipitation with semicarbazide): about 4-8 percent dehydroepiandrosterone (as semicarbazone)—but rarely more than 8 percent. The byproducts: a complex mixture of acid compounds that will later be recovered and processed into useful products.

Androstenedione can be made through oxidation; this is converted into the 3,enolbenzyl ether by treating with benzyl alcohol and muriatic acid. Catalytic reduction, followed by hydrolysis with HCl or other mineral acid, gives testosterone.

This product is the male sex hormone that is also used in the relief treatment of cancer in women. It sells at about $5,000 per kilo. Sterol Derivatives, Inc., now turns out 1.5-2.0 kilos of testosterone monthly; it is distributed throughout the world. Production methods are being expanded from a laboratory scale to what a heavy chemicals engineer would doubtless call a micro-commercial scale. But it takes as much sound judgment to do something well on a micro-scale as on a big one.

The propionate can be made by treating testosterone with propionic anhydride. The ester has a more prolonged effect on animals and man than testosterone.

Dehydroepiandrosterone (with a weak male reaction) can be made into orally-active methyl testosterone (with a strong male reaction) by a Grignard reaction with methyl magnesium bromide followed by oxidation. Or it can be made into pregneninolone (with a negative male—thus female—reaction) by treating with potassium acetylide in liquid NH_3, followed by oxidation. In this case, the methyl group seems to be tied in with male activity. Pregneninolone can thus be said to be comparable to an orally-active progesterone.

Sterol Derivatives also plans to make estrone and its derivatives on a commercial scale; raw material for these is pregnant mares' urine. Mercurophylline, a powerful diuretic, is being manufactured in 100-kilo batches.

Correction factor plots aid calculation of isothermal flow of gases in pipelines.

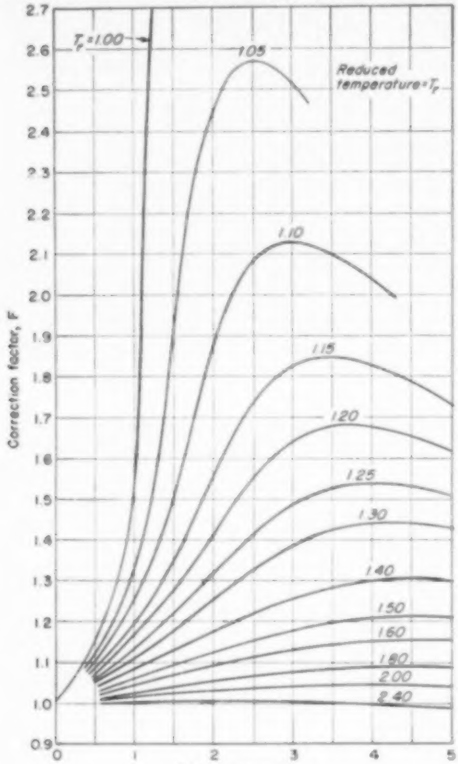

Fig. 1—Correction factors for gases showing normal behavior.

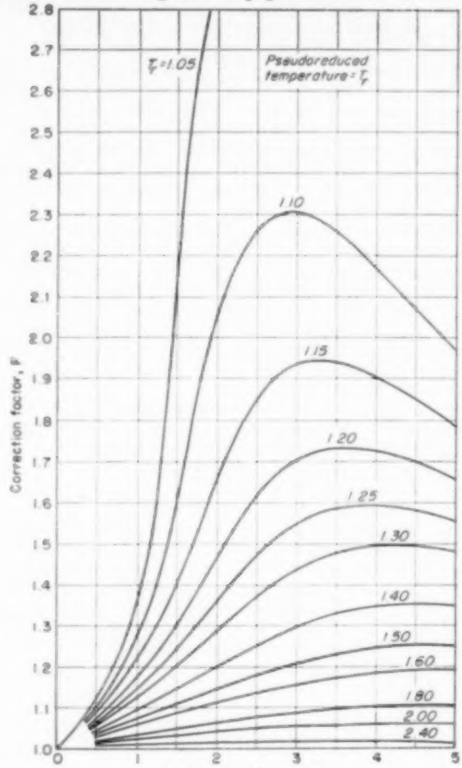

Fig. 2—Correction factors for natural gases containing methane.

Gas Flow in Long Pipelines

Using two correction factor plots the author simplifies calculation of isothermal flow of non-ideal gases at high pressures and in long pipelines

JOSEPH JOFFE

Equations for isothermal flow of gases in long horizontal pipes may be derived with the aid of the following expression[1] based on the mechanical energy balance:

$$-dp/v = (G^2/v\alpha g)\,dv + (2fG^2/gD)\,dL \quad (1)$$

In this expression α is close to unity for turbulent flow and the term in which it appears becomes negligible for long pipelines. The friction factor f is a function of the Reynolds number. It will vary slightly in long conduits of constant cross-section because of the effect of change in pressure on viscosity. If a constant mean value is assigned to f and if v is eliminated from the left side of Eq. (1) with the aid of the equation of state, $pv = zRT/M$, the following expression is obtained:

$$(M/RT)\int_{p_2}^{p_1}(p/z)\,dp =$$

$$(G^2/\alpha g)\ln(v_2/v_1) + 2f_mG^2L/gD \quad (2)$$

The first term on the right of Eq. (2) is negligible for applications to flow in long pipelines. If therefore a constant mean value is assigned to z, there follows from Eq. (2):

$$(p_1^2 - p_2^2)/z_m = 4RTf_mG^2L/MgD \quad (3)$$

While frequently z_m is taken as the arithmetic mean of the compressibility factors at entrance and exit conditions,[2] Biddison[3] recommends that for the flow of natural gases in long pipelines z_m be evaluated at a mean pressure p_m, where p_m is given by:

$$p_m = (2/3)\,(p_1^3 - p_2^3)/(p_1^2 - p_2^2) \quad (4)$$

Biddison's method is based on the assumption that $(1/z)$ is a linear function of the pressure in the pressure and

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temperature range under consideration.

A theoretically more rigorous approach is to evaluate the integral in Eq. (2) with the aid of an equation of state or a z-chart. Clinedinst[4] has used a generalized z-chart for natural gases to evaluate numerically the pressure integral, $\int_0^{p_r} (p_r/z)\,dp_r$, and has plotted isothermal values of this integral against the reduced pressure p_r. The left side of Eq. (2) is then found from the difference in the values of the Clinedinst integral at the initial and terminal pressures. Since the ideal gas value of the Clinedinst integral is $p_r^2/2$, a more useful graph may be obtained by plotting the ratio of the value of this integral to the ideal gas value as a function of reduced temperature and pressure. Let this ratio be termed the correction factor F for isothermal flow of non-ideal gases. Then F is defined by:

$$F = (2/p_r^2) \int_0^{p_r} (p_r/z)dp_r \tag{5}$$

With this correction factor Eq. (2) may be written:

$$(M/2RT)\,(F_1p_1^2 - F_2p_2^2) = (G^2/\alpha\, g) \ln(v_2/v_1) + 2f_mG^2L/gD \tag{6}$$

If the kinetic energy term is neglected, there follows the relationship:

$$F_1p_1^2 - F_2p_2^2 = 4RTf_mG^2L/MgD \tag{7}$$

which is analogous to Eq. (3).

A generalized plot of the correction factor F, given in Fig. 1, is obtained by numerical integration of Su's values[5] of averaged generalized compressibility factors for seven hydrocarbons. At low reduced pressures, up to p_r of about 0.5, the simplified generalized Benedict-Webb-Rubin equation of state[6, 7] based on the constants for propane was used to compute values of F. When gases and gas mixtures do not deviate appreciably from the law of corresponding states, Fig. 1 is suitable. However, for natural gases, in which methane is the principal constituent, deviation from the law of corresponding states is sufficiently large to render Fig. 1 inaccurate. Accordingly, Fig. 2 has been prepared by numerical integration, using z-values from a generalized z-chart for natural gases.[8] This graph is more convenient to read than graphs of the pressure integral for natural gases presented by Clinedinst.[4] Fig. 2 and Eq. (7) make it possible to solve problems in isothermal flow of natural gases at high pressures as rapidly and more accurately than with the aid of a compressibility factor chart and Eq. (3).

Example—A natural gas has the following composition in mol percent: methane = 60, ethane = 25, propane = 15. The gas flows in a long pipeline at 50 deg. F. The inlet pressure is 1,000 psia. and the outlet pressure is 300 psia.

The pseudocritical constants of the gas are computed as molal averages of the critical constants of the components. Accordingly, the pseudoreduced temperature of the gas is found to be 1.15, while the pseudoreduced pressures at inlet and outlet are respectively 1.485 and 0.445. From Fig. 2, $F_1 = 1.394$ and $F_2 = 1.077$. The left side of Eq. (7) has the value 129.7×10^4 (psi.)^2.

If Biddison's method is used, from Eq. (4) $p_m = 713$ psia. The compressibility chart for natural gases[8] gives $z_m = 0.717$, so that the left side of Eq. (3) has the value 126.9×10^4 (psi.)^2. Consequently, mass velocity G calculated from Eq. (3) is about 1.1 percent less than when calculated from Eq. (7). If z_m is taken as the arithmetic average of the compressibility factors at inlet and outlet conditions, the left side of Eq. (3) is found to have the value 124.1×10^4 (psi.)^2. As a result, the mass velocity G will differ from the value obtained with Eq. (7) by about 2.2 percent.

Nomenclature

- D = Internal diameter of pipe, ft.
- d = Differential.
- F = Dimensionless correction factor for isothermal flow of non-ideal gases.
- f = Fanning friction factor.
- G = Mass velocity, lb./(sec.) (sq. ft.).
- g = Conversion factor, numerically equal to standard value of acceleration of gravity, 32.17 (lb. mass/lb. force) (ft./sec.^{2}).
- L = Length of pipe, ft.
- M = Molecular weight.
- p = Pressure of gas, lb. force/sq. ft.
- p_r = Reduced pressure = p/critical pressure.
- R = Universal gas constant.
- T = Temperature, deg. F. abs.
- T_r = Reduced temperature = T/critical temperature.
- v = Specific volume, cu. ft./lb.
- z = Compressibility factor, pV/RT.
- α = Dimensionless kinetic energy correction factor.

Subscripts

- 1 Refers to inlet conditions.
- 2 Refers to outlet conditions.
- m Refers to mean value.
- r Refers to reduced value.

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Polytropic Compression

(*Continued from page 97*)

quired if there were no heat increase in the compressor other than the heat of compression. Once this comparison is fully understood, the confusion arising from a study of Figs. 2 and 3, and assumptions of n values equal or lesser than k, disappears.

The second problem mentioned arises in connection with reduced values of the polytropic efficiency e_p. Taking the case of air-handling compressors and solving Eq. (1a) for various values of $e_p = 0.283$; $n = 0$ when when $e_p = 0.283$; $n < 0$ when $0 < e_p < 0.283$; and $n = 0$ when $e_p = 0$.

This group of relations (shown in Fig. 3 for values of e_p greater than 50 percent) yields curves as at the right of Fig. 1 when plotted for all values of e_p. It remains to analyze the significance of these relations, a significance which the writer has never seen discussed in the technical literature on the theory of centrifugal compressors.

Referring these phenomena to the usual p-v diagram we have, in the left-hand portion of Fig. 1, a diagram of polytropic compressions for several values of n in the range where e_p is greater than $(k - 1)/k$. The right-hand portion (Curves a to d) shows additional cases where n = infinity and $e_p = (k - 1)/k$ in Curve (a); n is negative and $0 < e_p < (k - 1)/k$ in Curves (b) and (c); and $n = 0$ and $e_p = 0$ in Curve (d).

Curve (a) represents actually the case where the increase in volume due to the temperature rise in the compressed gas compensates exactly for the decrease in volume due to the increase in pressure. Inasmuch as in polytropic compression we can state that $p_1v_1^n = p_2v_2^n$ or $v_2 = v_1 \times 1/(p_2/p_1)^{1/n}$, then, if n = infinity, $(p_2/p_1)^{1/n} = 1$ and $v_2 = v_1$.

As to negative values of n (e.g., Curves b and c), they correspond to cases of such low polytropic efficiency that the temperature rise in the gas over-compensates the rise in pressure and the volume increases in spite of the pressure increase. Finally, when the polytropic efficiency is zero, the case corresponds to a centrifugal compressor operating wide open and discharging into the atmosphere. If we are to neglect the kinetic energy in the discharge from the compressor, the discharge pressure being equal to the inlet pressure, there is no work done and therefore the polytropic efficiency is zero. At the same time, there has been an increase in the temperature of the gas and hence an increase in volume, as shown by Curve (d) in Fig. 1.

Editorial Viewpoints

SIDNEY D. KIRKPATRICK and Staff

CED's Timely Warning

President Truman's report last month on the nation's economic health was tempered by the conviction that drastic governmental measures were neither necessary nor appropriate right now. But running through most of the message was an undercurrent of belief that production, wages and prices must somehow be controlled to give us that "strong and growing economy" we would all like to see. "Maintaining volume in the present situation is far more important than maintaining profit margins. . . . While price reductions are desirable, they should not be attained at the expense of wage cutting. . . . The benefits of improved technology and productivity should be reflected in the wage structure and in the price structure."

Most of us agree with such broad conclusions. Less acceptable to some was the President's insistence that governmental spending should be increased and other pump-priming means be used to bolster the declining economy. But the greater danger, it seems to us, still lies in the threatened extension of executive power into the control and allocation of the products and processes of private enterprise. Most timely, therefore, is the warning issued July 7 by the Research and Policy Committee of the Committee for Economic Development in its report on "The Uses and Dangers of Direct Controls in Peacetime."

Here are some cogent answers to the questions raised by such drastic proposals as the administration-sponsored H. H. 2756, introduced Feb. 15 by Representative Spence:

"To substitute direct controls for the price system is to attack the private enterprise system at one of the points where it works best and to introduce governmental intervention in an area where it is bound to be inefficient. . . . If government attempts to decide what shall be produced and how it shall be distributed, there will inevitably be unsatisfied demands for some commodities and unsalable supplies of others. The very complexity of the task insures that, even with the utmost administrative skill, serious mistakes will be made."

We are convinced, with CED, that direct governmental interference with production and prices is certain to impede rather than accelerate the dynamic growth of the American economy. "Our enterprise system thrives on the search for new products and new techniques. All of us benefit from the constructive actions of those who have vision and are willing to take new risks. Governmental controls that determine what can be produced and the price that can be charged strike at the very roots of a successful enterprise system."

Anglo-American Productivity

Britain's latest economic crisis is of concern to every thinking American. Collapse of her economy would prove disastrous for generations yet unborn to our common heritage. Hence in these times all of us should be willing to make concessions that under ordinary circumstances would seldom be permitted. In fact, some American chemical manufacturers might even go so far as to permit British engineers and technologists to visit and inspect their plants.

These thoughts result from the reading of a digest of the reports made by the first team of industrial specialists sponsored by the Anglo-American Council on Productivity, following their recent visit to 20 American steel foundries. They observed many practices and techniques whereby American management makes up for the greater skills and craftsmanship that characterize British operations. They were impressed with our cooperative research, particularly what they saw at Battelle Institute, and they intend to establish means for international collaboration along these lines. But they also found certain areas—such as cost finding and cost control—where American steel foundries are not so advanced as those in Great Britain. So there may be immediate as well as long-range gains to us from this intimate exchange of production know-how and experience.

The Anglo-American Council, headed in America by Philip D. Reed of General Electric Co., and in England by Sir Frederick Bain of ICI, has already received applications for visits to this country by more than 30 productivity teams from British industries. The normal program for each team involves a stay of six weeks over here. This is preceded by a pre-

liminary period of study before leaving home and followed by a further period for disseminating to British industries the experience the team has gained during its visits here. In all, more than three months are needed and during this time the team members are on paid leave of absence from their employing firms. Expenses for travel and subsistence are paid by the two governments. The average sterling cost for each member of a productivity team is about £350 ($1,400), while the dollar cost is in the neighborhood of $1,000 (£250).

The work of the Council is not a "one-way street." The British section will welcome a reverse flow of teams from this country. Research already under way will prove helpful in measuring productivity, promoting standardization, simplified practice and desirable specialization in the production of component parts. Those who seek further information should address Jean Jerolaman, recording secretary of the Anglo-American Council on Productivity, c/o the Economic Cooperation Administration, Suite 1221, 2 Park Ave., New York 16, N. Y.

Big Business and Little Minds

Our legal understanding is too limited to comprehend all that's back of the government's suit against Du Pont, General Motors and U. S. Rubber. There was a time when we thought we understood and applauded the workings of the Sherman and Clayton anti-trust laws. In our naivete, we thought they were enacted for the primary purpose of protecting the general public. They prevented monopolies from gouging the customer by charging higher prices for shoddy goods. They prevented the throttling of competition or the stifling of technological progress by withholding inventions for improved processes and products. We somehow thought that as long as the consumer was fairly served with better goods at ever lower prices, it didn't make much difference whether the suppliers were big or little businesses, one or many. Now it is obvious that such thinking is out of date. Bigness per se must be bad. We must make little ones out of the big ones even though the public may have to pay higher prices for poorer products from less efficient producers.

Attorney General Tom Clark's explanation of the suit filed last month in the U. S. District Court in Chicago did not help to clear up our confusion. He said, "This case is directed to the breaking up of the largest single concentration of industrial power in the United States. The growth of Du Pont, General Motors and United States Rubber to market dominance in their respective fields has been marked by the elimination of many independent businesses and a decline in the strength and vigor of those that survived. The relief sought in this case will be to open the way for small and medium-sized manufacturers to compete for business in markets which have long been closed to them."

There is nothing here about the public interest, about whether the American people have been adversely affected in their living standards, their health, comfort and national security. Nothing is said about higher prices to the consumer. In fact, one of the government's complaints is that inter-company sales were sometimes made at substantially lower prices than could be obtained from other sources. This is reminiscent of the cellophane indictment of Du Pont for having steadily reduced its costs and prices to levels at which no one else could compete.

The statements issued by executives of two of the companies involved is in marked contrast with that of the Attorney General. Crawford Greenewalt said, "The Du Pont Company emphatically denies that relationships with General Motors and the other companies mentioned in the complaints have been illegal or in any way detrimental to the interests of the people of the United States. On the contrary, these relationships have served the public interests in a conspicuous way and in that firm belief we will defend our actions and our present position with the utmost vigor." Herbert Smith, board chairman of U. S. Rubber, said, "We are in business to serve the public by providing the best possible products at the lowest possible prices. . . . We believe that a company, like an individual, prospers only to the extent that it serves and that bigness in business is a reliable sign of service."

Were it possible to try this case along such simple lines, even minds as small as ours might understand and comprehend the issues involved. More important, it might bring home to the general public the very real contributions which these organizations have made to the American way of life—to our health, happiness and prosperity.

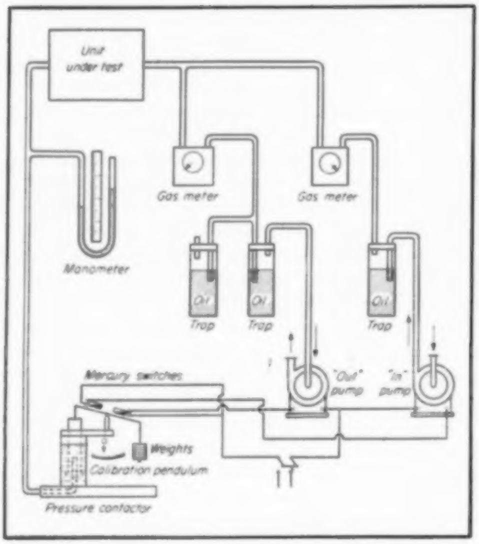
Andrew M. Fairlie, 1877-1949
Charles A. Mann, 1886-1949

These two chemical engineers—one an outstanding practitioner and consultant, the other a great and inspiring teacher—will be sorely missed by our profession. Both were hardy pioneers that left the beaten trails to carry on their work against discouraging handicaps.

Chemical engineering in the South gained a lot from that hard-working, serious-minded Scot whose name will long be identified with her sulphuric acid and fertilizer industries. Minnesota alumni held no monopoly on our affection and respect for Charlie Mann. His warm freindship and human qualities endeared him to tens of thousands of chemical engineers the world over. We mourn the passing of these men, but will always cherish our memories of them and their work.

The Plant Notebook

THEODORE R. OLIVE, Associate Editor



New Instrument Arrangement Measures Vessel Leakage at Low Pressures

MAX F. MUELLER, *Chemical Engineer, Baltimore, Md.*

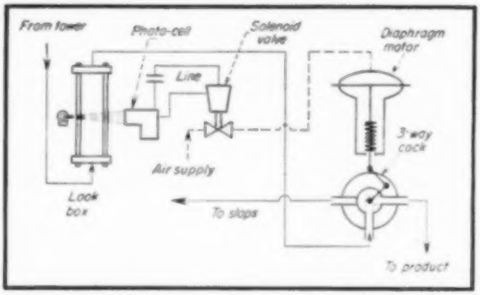
★ **June Contest Prize Winner**

The common method of measuring leakage of units by introducing air under several pounds pressure and obtaining a plot of absolute pressure versus time cannot be utilized when the unit to be so tested is unable to withstand pressures greater than a few inches of water. To determine the magnitude of leakage at these low pressures, a leak testing device has been devised which accurately measures this condition.

The unit under test is connected to a manometer and to a pressure contacter as shown on the accompanying sketch. The pressure inside the inverted bell of the pressure contacter is at all times equal to the pressure inside the unit, and the bell rises and falls in accordance with the pressure. This pressure bell is suspended in an oil bath in the manner of a small gasometer. The lever arm from which the bell is suspended is counterbalanced by a system of weights. Sufficient weights are added so that the lever arm is in a horizontal position at say 2 in. water pressure. At pressures other than 2 in. w.g., the pressure bell moves up or down as the case may be, the amount of movement being adjusted by the length and weight of the calibration pendulum. Two pumps are used to control the pressure, each being connected to the unit under test through a gas meter. The purpose of the traps in the line between the pumps and the gas meters is to prevent air from being lost by leakage through the pumps. The trap connected in the line between the "out" pump and its gas meter acts as an automatic relief valve in the event that an unforseen condition should cause a dangerously high pressure.

HOW IT WORKS

The two pumps are operated by the mercury switches on the lever arm of the pressure contacter. In the position shown on the sketch, there is an excess of pressure within the unit, as would be caused by an increase in ambient temperature, or a decrease in barometric pressure, and the right hand switch has made an electrical contact which has turned on the "out" pump. This pump will continue to operate until the pressure has been reduced to the arbitrarily set 2 in. w.g. level at which time the lever arm will again be horizontal, the mercury switch will break contact, and the pump will be turned off. When the pressure in the unit falls below 2 in. due to a decrease in temperature, an increase in barometric pressure, or leakage, the lever arm will tilt downward to the left causing the left hand mercury switch to make contact which turns on the "in" pump. The "in" pump then operates to bring the air pressure in the test unit back to 2 in. w.g. The pressure contacter is sufficiently sensitive so that the 2 in. w.g. pressure is maintained at plus or minus 0.1 in. w.g. during a test run. Knowing the starting and end conditions of temperature and absolute pressure and the number of cubic feet of air pumped in and out by the two pumps, it is an easy matter to calculate the leakage at 2 in. w.g. pressure (or any other desired pressure).



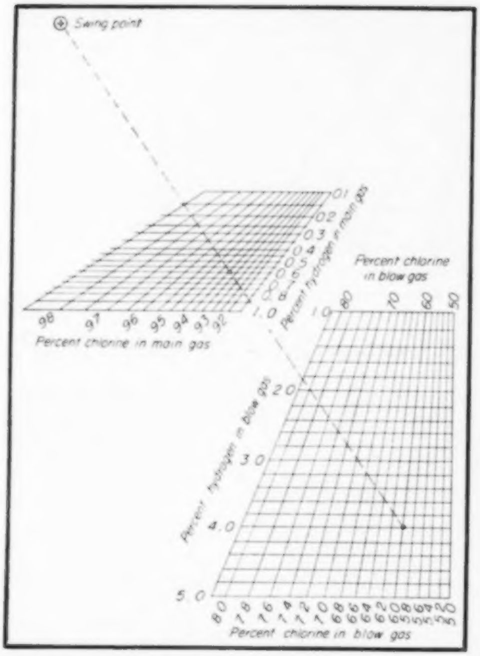
Protecting Tower Output From Off-Color Products

H. S. EDRINGTON, *Lake Charles, La.*

A photo-cell installed on a look-box so that the beam can supervise the rundown line downstream of a tower and condensers can be used effectively in protecting the tower products from "pukes" from the tower. Off-color material, or naphtha or kerosene, can thus be diverted automatically to a slop tank and kept out of the rundown tanks. The diagram illustrates the system which consists in combining a photo-cell with a solenoid valve controlling air to a diaphragm operated three-way cock.

In operation, when the tower sends over dark material,

the light beam is broken, the solenoid operates, admitting air to the diaphragm, and diverting the stream immediately to the slop tank. As soon as the stream clears the operations reverse automatically, sending the stream again to the rundown tank. The system will pay for itself in a short time by preventing off-color or off-specification material, which normally would have to be re-run at considerable added expense.



Percent of Hydrogen in Electrolytic Chlorine

Joseph I. Lacey, *Hooker Electrochemical Co., Niagara Falls, N. Y.*

Nearly all of the commercial chlorine produced in this country today is made by the electrolysis of sodium chloride, and a major portion of this is made from salt solutions. Due to the nature of the electrolytic cells the chlorine produced always has small quantities of hydrogen in it, along with other gaseous impurities.

This chlorine may be liquefied by suitable cooling and compressing, but a residual gas consisting of chlorine, hydrogen, and other non-condensibles remains in the vapor phase. This gas is known as blow gas or sniff gas. In a similar fashion the gas coming from the cells is known as main gas. The quantity of hydrogen in the main gas must be known in order that the cells may be operated in a efficient manner. It is common practice for chlorine plant operators to check this value at fairly frequent intervals.

One method of finding the percent of hydrogen in the main gas is to analyze the blow gas for percent of chlorine and the main gas for percent of chlorine, by absorbing a known volume of the gases in caustic. The percent of hydrogen in the blow gas is found by a combustion technique. The percent of hydrogen in the main gas could also be found by combustion, but the amount of original sample is quite large. It is more convenient to calculate the percent hydrogen in the main gas as equal to (percent H_2 in blow) × (100 − percent Cl_2 in main) ÷ (100 − percent Cl_2 in blow).

It should be noted that this equation is valid if the actual percent of chlorine is used, or if the percent absorbed in caustic (which is actually percent of $Cl + CO_2$) is used, providing the same analytical procedure is used to determine the percent of chlorine in both gases. The three analytical results must be in consistent units, i.e., volume percent, weight percent, etc., and the calculated result will then of course come out in the same units.

To Eliminate Calculation

A nomograph has been prepared relating the terms of this equation. To use this chart draw a straight line through the "Swing Point" to the intersection of the lines corresponding to the values of the percents of chorine and hydrogen in the blow gas. The swing line will then intersect a line corresponding to the percent of chlorine in the main gas. This intersection will also intersect a value of percent of hydrogen in the main gas, which is the desired figure. If any three of the four variables are known, the fourth may be found by following the procedure outlined above. The routine use of the chart is greatly simplified by placing a permanent line at the Swing Point. This may be a piece of string tied to a thumb tack through the Swing Point, or it may be a piece of transparent plastic with a line etched on it, with the line pivoting at the Swing Point.

The use of the chart may be best illustrated with an example. Assume that a certain blow gas has 60 percent

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JULY PRIZE WINNER—A $50 prize will be issued to . . .

WALTER R. EHRICHS
Jackson Laboratory, E. I. du Pont de Nemours & Co., Wilmington, Del.

. . . for an article describing a simple, inexpensive double-acting valve which not only prevents flow reversal but also limits the discharge rate from the vessel. This article has been judged the winner of our July Plant Notebook contest, and will be published in our September issue.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook.

The winner each month will be announced in the issue of the next month, e.g., the August winner will be announced in September and his article published in October. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at our usual space rates.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Articles may deal with any sort of plant or production "kink" or short-cut that will be of interest to chemical engineers or others in the process industries.

Also, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

Cl_2 and 4 percent H_2. A sample of main gas taken at the same time contains 94.0 percent Cl_2. Find the percent hydrogen in the main gas. To solve this using the nomograph, locate the intersection of 4 percent H_2 in the blow gas and 60 percent Cl_2 in the blow gas. Draw a straight line from this intersection to the Swing Point. At the point of intersection of this line and the line for 94 percent Cl_2 in the main gas, read 0.6 percent as the hydrogen in main gas line.

Industrial Trucks as Floor Loads

A recent study of the floor loads imposed by industrial power trucks provides a simple rule for determining whether a more careful study will be necessary to assure safety. This study, conducted by the Philadelphia Division of Yale & Towne Mfg. Co., shows that the truck may be expected to impose a dynamic load on the floor about 1½ times the static weight of the loaded machine. Since the truck is considered as a concentrated load, the bending moment it produces is about twice that for uniform loading. Therefore the combined effect of these two considerations is that the floor stresses produced by the moving loaded truck will be about three times those produced by uniform loading conditions.

To determine what truck load is given floor will carry, consider the area comprising one bay. If a 10-ft. width of a 20 × 20-ft. bay is aisle and if the rated floor capacity for static loading is 250 lb. per sq. ft., then the allowable static load for the 10 × 20-ft. aisle area is 10 × 20 × 250 = 50,000 lb. Applying the factor of three, the allowable loaded truck weight is 16,600 lb., provided that the storage areas along the aisle are not overloaded. Two or more trucks can pass if their combined weight does not exceed 16,600 lb. a factor that must be watched particularly at elevators.

Since these tests applied particularly to concrete slab types of floor construction, further studies may be necessary with other types of floor, especially wooden floors where only a few boards may receive the full weight of the truck. Furthermore, if the weight of the proposed trucks approaches the indicated safe loading, a detailed study by a competent engineer should be made.

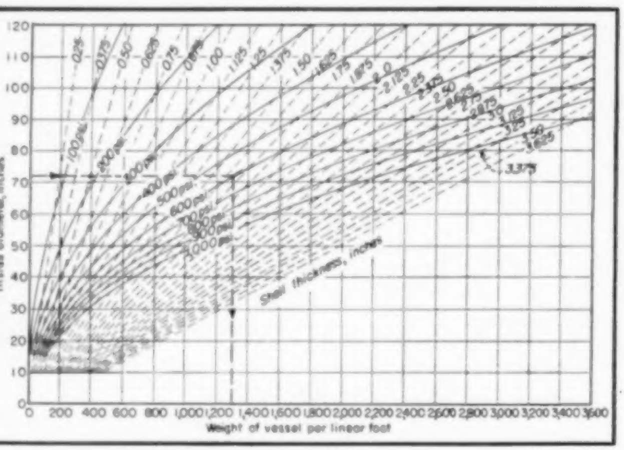


Chart for Determining Weight and Wall Thickness of Pressure Vessels

Ray D. Holland, *Student, University of Oklahoma, Norman, Okla.*

In the design of cylindrical pressure vessels it is often desirable to get a quick estimate of the dimensions of the vessel being designed. The purpose of this article is to give a method for the quick construction of a chart which relates working pressure, inside diameter, shell thickness and weight of the vessel per foot of length in so-called thin-walled vessels, where the wall thickness is not over 10 percent of the inside diameter. The thickness of a vessel depends on the type of metal being used and the longitudinal joint efficiency; therefore a chart of this kind is best designed for one type of metal and one value of E. The equations given were derived from the equation $t = PD/(2sE - P)$ employed in the API-ASME Code.

To get a relation correlating pressure, diameter and weight, we set up a coordinate graphing system with D (inside diameter in inches) as ordinate and W (weight of vessel in pounds per linear foot) as abscissa. We can use the equation $W = P\pi\rho D^2/144(2sE - P)$, where P = pressure, psig.; ρ = density of metal, lb. per cu. ft.; s = maximum allowable working strength of metal, psi.; and E = longitudinal joint efficiency. Taking suitable values of E and ρ (which are characteristic of the metal and design), we then plot D versus W for those values of P which will be useful.

For example, the accompanying chart was drawn for ASTM A 201 grade A steel, for which s = 13,750 psi., ρ = 490 lb. per cu. ft. and E = 0.95. For P = 200 psig., $W/D^2 = 200 \times 3.1416 \times 490/144\ (2 \times 13{,}750 \times 0.95 - 200) = 0.08255$.

To correlate thickness with diameter, pressure and weight, we use the equation $D = 144\ W/t\pi\rho$, where t = shell thickness in inches, and plot D versus W using regular thicknesses in $\frac{1}{8}$-in. increments. This gives a group of straight lines through the origin, so only one point has to be plotted for each thickness.

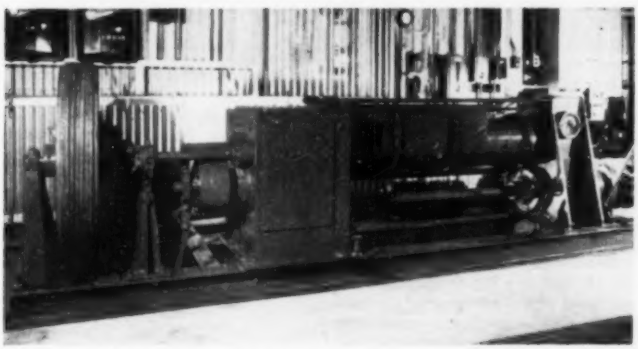
Use of the chart can best be explained by an example. A 72-in. I. D. vessel is to be designed for a working pressure of 600 psig. Go across on the 72-in. diameter line to the 600 psig. line. Minimum thickness is approximated by the thickness lines on each side of the intersection. Minimum thickness is about 1.69 in. Weight per foot of the vessel is given directly below as 1,300 lb. Corrosion allowance can be easily made by going to any thickness line to the right of the intersection.

Correction for Mean Diameter

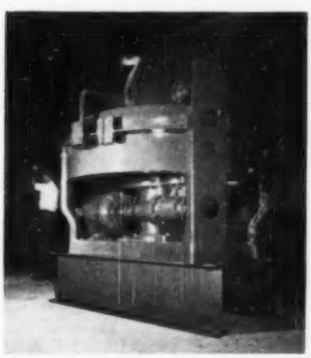
Weight per foot of vessel as found above was based on inside diameter instead of mean diameter. The error in weight is small except for thick-shelled, large-diameter vessels for which the formula is inapplicable. If greater accuracy is desired, first find the thickness, including corrosion allowance, and add this to the inside diameter. Calculate the weight for the mean diameter and corresponding thickness.

Pilot plant is equipped to duplicate all manufacturing unit operations.

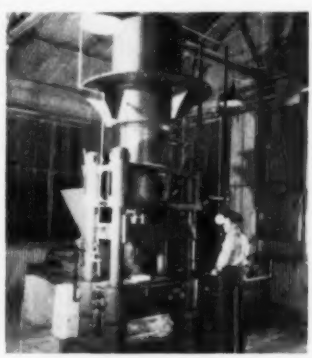
Pilot Plant and Research at New Refractories Lab



EXTRUSION UNIT de-airs clay and extrudes through a die large enough to form standard 9-in. straights. A smaller extruder is equipped with a 2-in. square die.



DRY PAN is used for crushing and grinding refractory raw materials.



HIGH SPEED PRESS of 450 tons capacity molds dry press brick.

Opened officially on June 29, the new Baltimore research laboratory of the General Refractories Co. is one of the most complete in the industry. It provides not only all facilities needed for studying refractories at all stages from raw materials to finished product, but also includes a pilot plant in which all manufacturing processes can be carried out on full commercial scale, under strict laboratory control.

The new laboratory comprises two buildings joined by a connecting passage—a brick and concrete building housing all chemical, physical and petrographic research facilities; and a steel and glass factory type building, half of which is occupied by the pilot plant, the other half by the furnace room for high temperature testing.

Practically every modern instrument for the study of refractories is provided in the first building. In addition to sampling room and chemical laboratory, there are laboratories for petrographic microscopy, spark spectrography, X-ray diffraction with both Geiger-counter and film-recording instruments, thermal expansion, and high temperature studies.

The pilot plant contains nearly a score of machines ranging from small scale equipment to full production size. Quantities handled can range from a few hundred pounds to several tons and experimental quantities of up to several hundred brick can be made without interfering with regular production facilities. Not shown in the view above is a 3 x 30-ft. rotary kiln for dead-burning raw materials.

Concentration by Convection

How, and when, to concentrate a solution by passing dry gas through it. Like vacuum boiling, it's a tool for low-temperature concentration.

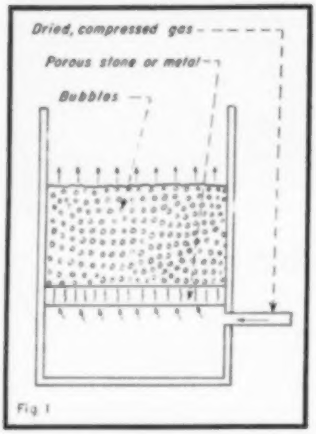
EDWARD LEDOUX

Two different procedures are available for concentrating liquids at low temperatures. The choice between one or the other, or a combination of the two, depends on (1) the total amount of water to be removed, and (2) the hygroscopic characteristics, that is the shape of the equilibrium isotherms, of the solution under consideration.

Concentration or desorption can be effected by boiling under a vacuum, which is the first of the two procedures. Operating temperature may be lowered considerably by use of a cooled adsorber instead of the usual condenser.[1] Fast action in this process is due to the liberation of the vapors within the body of the boiling liquid, thus insuring a large surface for vapor transfer. However, the vapor pressures of the adsorbents increase as they take up water; so with vacuum concentration by adsorption you can't concentrate very much with reasonably sized adsorption equipment.

The alternate procedure consists in contacting the solution with a flow of gas which is at a low temperature and has been dried to a very low dew point. This system does permit large concentration variations. Even though the gas possesses a low sensible heat, it is still capable, in its very dry condition, of taking up and removing much desorbed water. The driving force is the difference between the equilibrium vapor pressure of the solution and the vapor pressure in the gas. The former is low since the solution is held at low temperature. Since the latter should be lower still, it is apparent that low temperature convection concentration requires a gas so dry that it can be obtained economically only by adsorption dehumidification.[2]

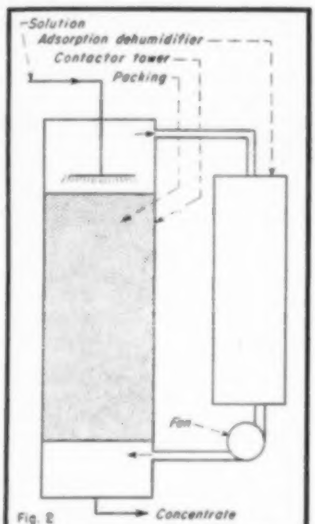
In this method, the water vapor is evolved by surface evaporation, a much slower process than that of boiling. Therefore an important consideration of apparatus design is to provide the largest possible surface of exchange and coefficient of transfer between liquid and gas.



BATCH set-up bubbles compressed, dried gas through solution to be concentrated.

For small batch operations (Fig. 1) the dry gas may be bubbled through the liquid. Compressed dry gas is admitted through a porous stone or a porous metal dispersion unit in the bottom of the vessel containing the solution. This generates very fine and uniformly distributed bubbles, thus creating a large surface of exchange.

In large continuous operations, the solution and gas contact in counterflow in a bubble-cap column or a packed tower. The solution to be concentrated moves downward by gravity and the concentrate is removed at the bottom of the tower. The dry gas, of course, enters the bottom of the tower. Since the operation is one of steady state, the absolute humidity of the gas emerging at the top of the tower remains constant. With atmospheric air as the gas, the operation may be either in open circuit or closed circuit as shown in Fig. 2, depending on whether the absolute humidity is lower or higher than that of the outlet gas. When inert gases such as nitrogen or carbon dioxide are used to avoid oxidation of the solution, the operation must be in closed circuit.



CONTINUOUS gets gas-solution contact in packed tower; adsorber dries gas again.

The continuous desorption operation which takes place in the evaporator may be carried out isothermally or adiabatically. In the first case, the heat required for desportion is supplied by heating elements inside the evaporator tower; in the second it is supplied from the sensible heat of the gas itself. Continuous desorption under both these conditions has been discussed in detail elsewhere.[3,4]

EDWARD LEDOUX, *an engineer with Attapulgus Clay Co. of Philadelphia, is well-known to* Chemical Engineering *readers as an authority on adsorption.*

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Corn Wet Milling

Article on page 92

From 36 million bushels in 1906, consumption of corn by the U. S. wet milling industry climbed to an all time high of 139 million bushels in 1947. It slipped to 109 million last year, where it is expected to level off. That's still a lot of corn. Here's how some of it is processed.

At Clinton Industries' 42-acre wet milling plant in Clinton, Iowa, operations begin with the arrival of shelled corn, 27 carloads of it a day. Operations end with the manufacture of various grades of sirup and starches, dextin, crude and refined sugars (dextrose), refined edible oils, lactic acid, and livestock feeds.

Removed from box-cars by mechanical shovels, the corn is thoroughly cleaned by a series of screens and air separators. Then it is steeped for two days in a controlled solution of surplus dioxide (120-130 deg. F.) which softens the kernels and inhibits fermentation.

A series of mechanical separations removes first the germs, then the hulls, and finally the gluten, from the kernels, leaving only starch. This is then hydrolyzed in large bronze pressurized converters breaking it down into dextrins and sugars. The solution is neutralized with sodium carbonate, then skimmed, filtered, evaporated, carbon refined, and vacuum concentrated. For the manufacture of corn surgar the original starch is completely hydrolyzed, dextrose is crystallized, and separated from the corn sirup molasses in basket centrifugals.

Lactic acid is produced by the fermentation of dextrose. Some of the partially refined sugar liquors are cast in molds producing crude sugar. Corn sirup is only partially hydrolyzed but thereafter treated the same as sugar.

Starch not to be hydrolyzed into sugars is pumped to the starch plant where it is processed into gloss starch, pearl starch, powdered starch, acid modified starch, oxidized gum starch, and dextrin.

Corn oil is obtained from the germ by crushing it in an oil expeller. Further oil extraction is obtained by solvent extraction with hexane. Oil is treated with alkali to remove free fatty acids. Then it is washed, dried bleached with activated carbon or clay, and dewaxed by chilling.

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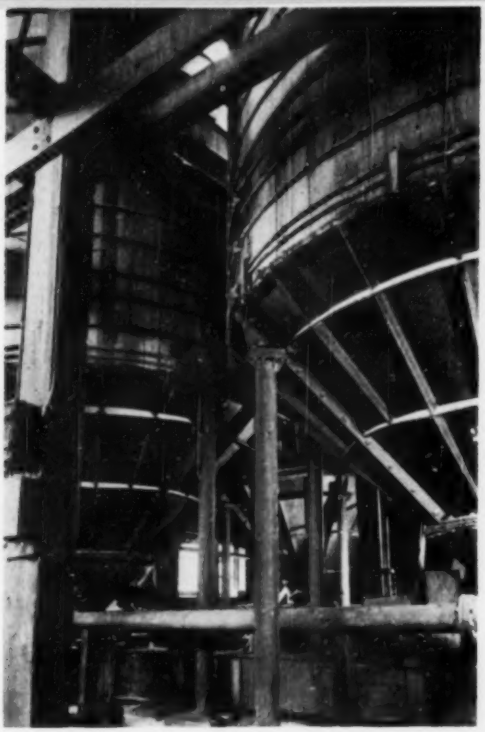
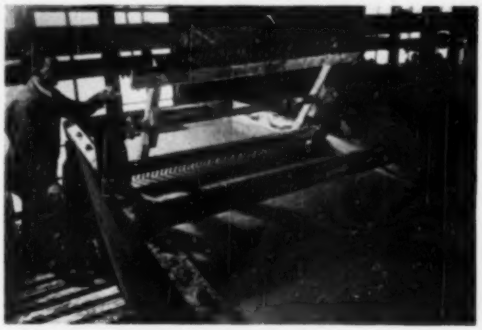
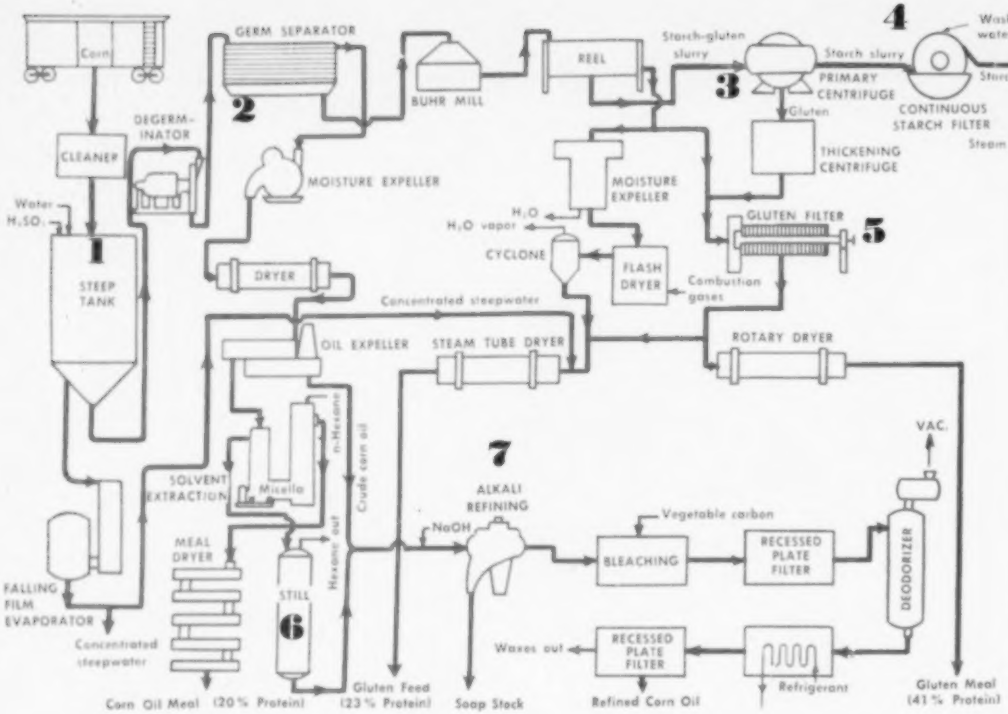
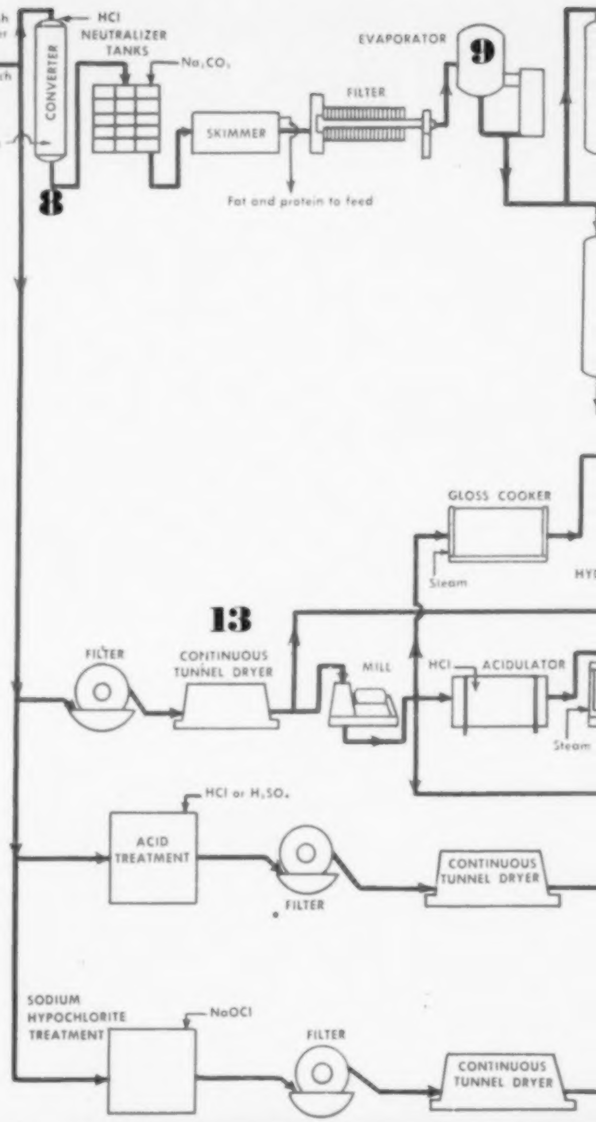


1 STEEP TANKS in which corn is soaked for two days to soften kernels and inhibit fermentation.



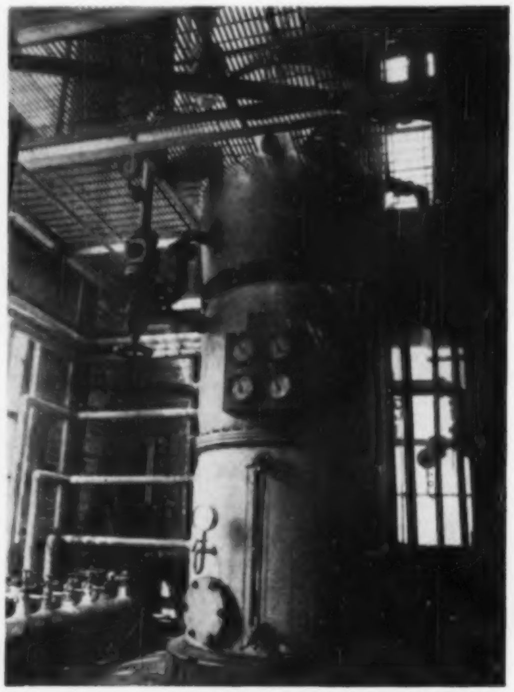
2 GERM SEPARATOR is a settling tank where germs rise to top and are carried off in overflow.

3 CENTRIFUGAL SEPARATOR represents new method for removing gluten from starch.

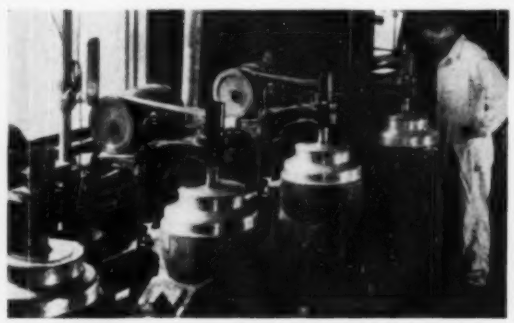



4 **CONTINUOUS VACUUM FILTERS** wash last traces of soluble materials from the starch.

5 **GLUTEN FILTER** de-waters gluten to wet cake. Further dried it is used in gluten feed.

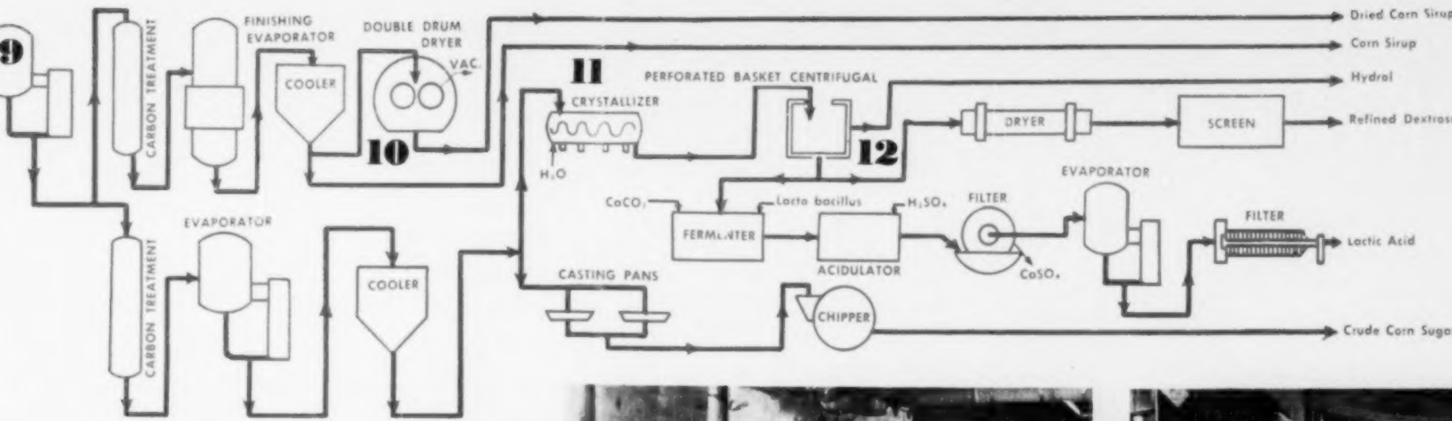


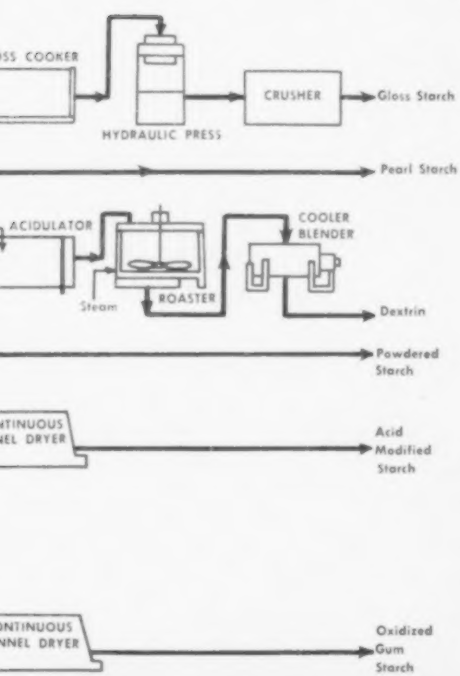
6 **STILL** removes hexane (solvent) from corn oil (solute). Solvent extraction recovers last of oil from germ.



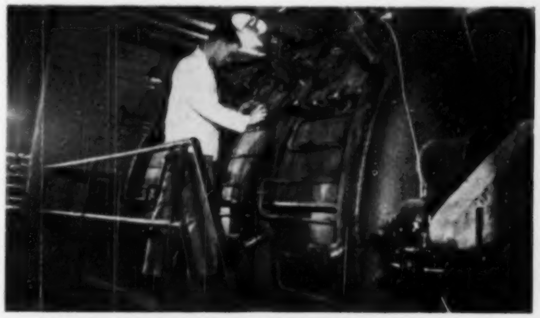
7 **HIGH SPEED CENTRIFUGAL SEPARATORS** remove free fatty acids from crude oil. Byproduct: soap stock.

8 **CONVE**
and suga

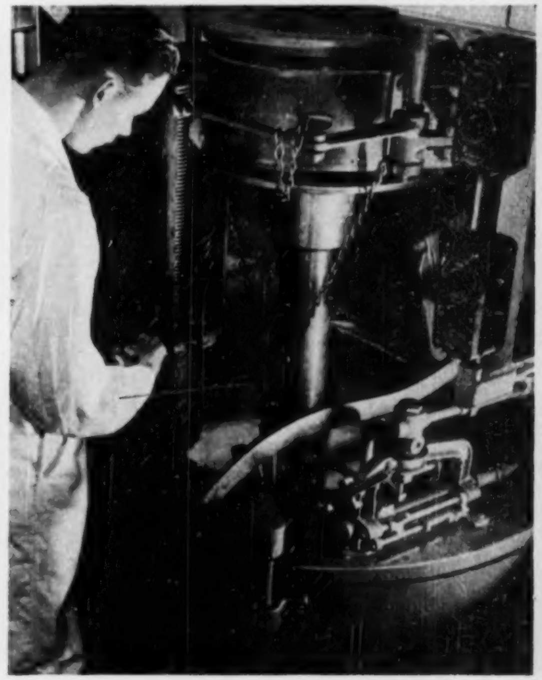




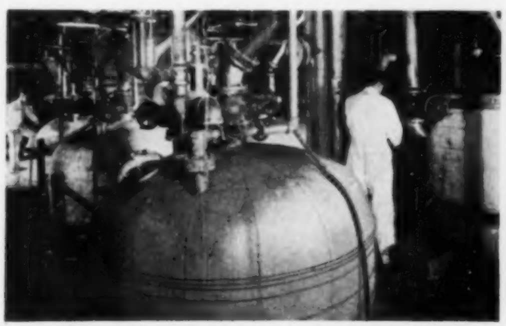
9 **TRIPLE-EFFECT VACUUM EVAPORATOR** partially concentrates pure corn sirup liquor before it is decolorized.



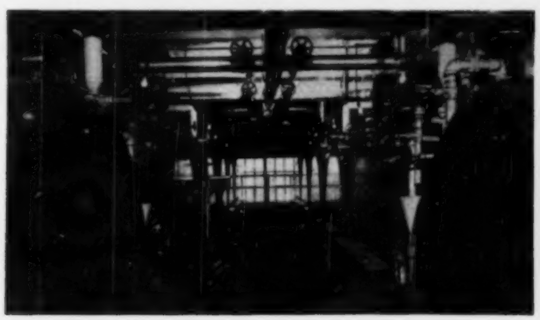
10 **VACUUM DOUBLE DRUM DRYER** is postwar equipment for the production of a new product, dried corn sirup.



12 **PERFORATED BASKET CENTRIFUGAL** separates dextrose crystals from hydrol and washes them.



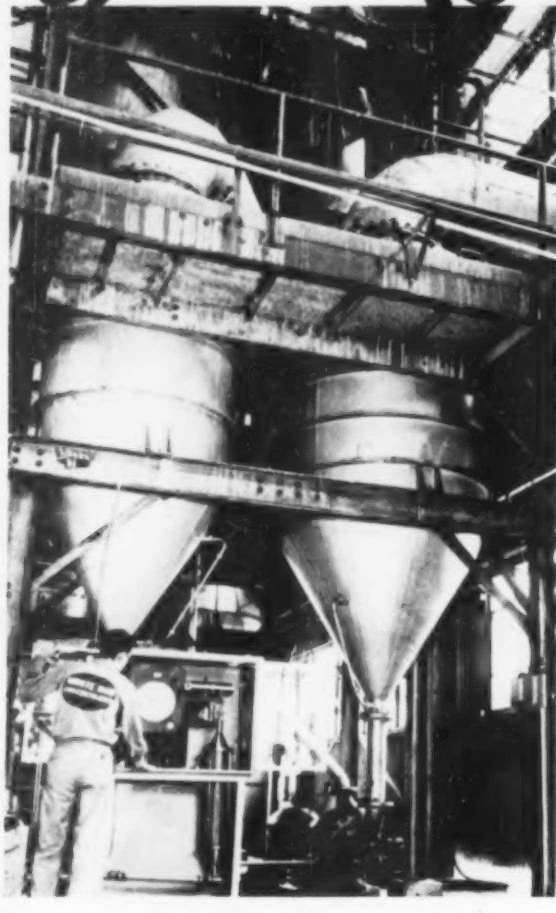
8 **CONVERTER** in which starch is broken down into dextrins and sugar. HCl is the catalyst.



11 **CRYSTALLIZERS.** Refined sugar leaves these units in small crystals of pure dextrose suspended in hydrol.

13 **CONTINUOUS TUNNEL DRYER** where warm air dries starch down to below 14 percent moisture.

. . . LAST
AND
ALWAYS
WITH
BUFLOVAK
LOW TEMPERATURE
EVAPORATORS



You *must* safeguard the good qualities of your concentrated product, you say to yourself—First, last and always. BUFLOVAK knows your problem on that score, and meets your need with its new Low-Temperature Evaporator. At no time during the processing of even the most delicate materials does it "tamper" with the product's qualities, even when the Evaporator is run over long operating periods. And, always, there is a high recovery of solids. Think of the savings you realize in this feature alone!

Profits are increased, also, by maintaining high product quality continuously, at low production costs.

BUFLOVAK'S Low - Temperature Evaporator has already established its value in plants where installed

There is a BUFLOVAK Evaporator for every Industrial Purpose, Dryers, Chemical and Food Processing Equipment. Write us today for full information on our complete line of equipment.

BUFLOVAK EQUIPMENT

Division of Blaw-Knox Co.

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For complete selection .

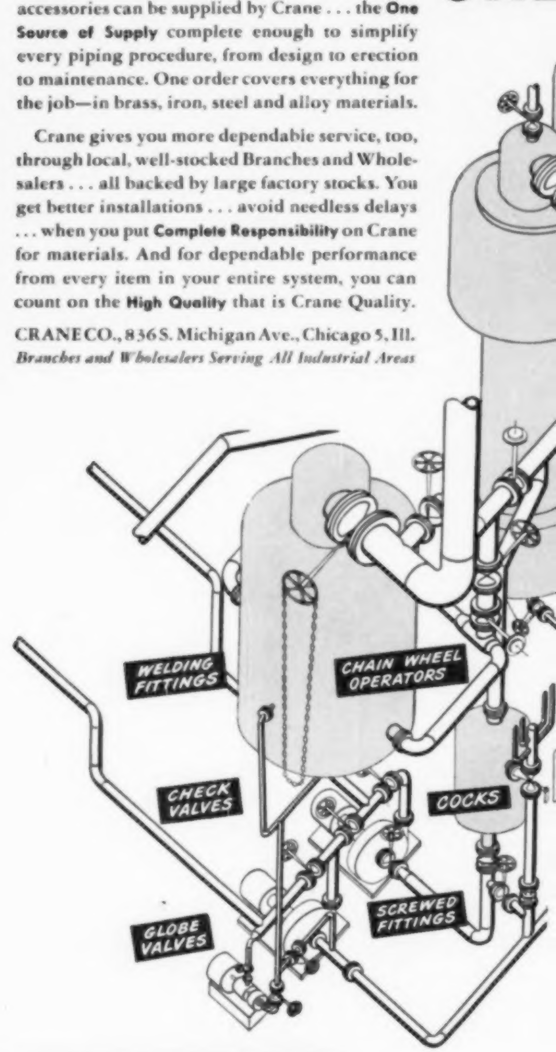
Look to th

ONE

There you'll most likely find whatever you need in piping equipment. **Take This Evaporator Installation,** for example. All valves, fittings, pipe and accessories can be supplied by Crane . . . the **One Source of Supply** complete enough to simplify every piping procedure, from design to erection to maintenance. One order covers everything for the job—in brass, iron, steel and alloy materials.

Crane gives you more dependable service, too, through local, well-stocked Branches and Wholesalers . . . all backed by large factory stocks. You get better installations . . . avoid needless delays . . . when you put **Complete Responsibility** on Crane for materials. And for dependable performance from every item in your entire system, you can count on the **High Quality** that is Crane Quality.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
and HEATING

CRA

Process Equipment News

THEODORE R. OLIVE, Associate Editor

EASILY INSTALLED:

Tubular Tank Heater

Brown Fintube Co., Elyria, Ohio, has developed a new tank heater known as the Thermo-Flo which can be used as a single unit in small tanks, or manifolded in suitable numbers and arrangements in larger tanks. The heater employs vertical tubes, grouped 12 tubes to a unit, each tube being provided with longitudinal fins to give heat-transfer surface equivalent to six times the length of bare plain pipe. The vertical installation reduces fouling and avoids the necessity of heating through a layer of sediment. Heaters may be installed as shown in the illustration, or if roof manholes are available, can be suspended from the top of the tank to permit service while the tank is full. It is claimed that the installed cost of these heaters is acutally less than the installed cost of bare pipe coils having equivalent heating capacity.

ALL-ELECTRIC:

Duplex Bagging Scale

Richardson Scale Co., Clifton, N. J., has developed a new all-electric automatic duplex bagging scale for packaging a wide variety of free-flowing materials in open-mouth paper or textile bags. Known as the Model E-50 duplex, the bagger comprises two scales with a common bagging spout. The normal range is from 5 to 25 lb., and from 25 to 50 lb. Units of greater capacity can be furnished for special applications. Extremely fast, the device is capable of handling 24 bags of 10 lb. weight or 18 bags of 25 lb. weight per min. The construction is totally inclosed and dust-proof, conforming to code requirements for Class 2, Group G hazardous locations.

QUICK, PORTABLE:

Air-Driven Pipe Saw

The E. H. Wachs Co., 1525 North Dayton St., Chicago 22, Ill., has introduced a new air-powered pipe saw which cuts cast iron or steel pipe from 12 to 48 in. in diameter, at rates up to 2 in. per min. The machine operates on 85 psi. air, uses a high-speed steel milling cutter which leaves clean edges, and is easily adjusted to different sizes of pipe. The saw is strapped tight to the pipe by two silent type chains which act as a flexible ring gear for positive feed. As the saw cuts, it travels around the pipe. Cuts above ground are made by rolling the pipe on skids, while underground cuts require only 14 in. clearance in the ditch. Since the construction is sealed, cuts can be made under water in flooded ditches.

Marshall and Stevens Indexes of Comparative Equipment Costs

(1926 = 100)

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, *Chemical Engineering*, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see *Chemical Engineering*, Feb. 1949, p. 129.

Industry	June 1948	Mar. 1949	June 1949
Average of all	160.5	165.1	160.6
Process Industries			
Cement mfg	153.9	159.5	155.9
Chemical	161.9	167.5	163.9
Clay products	148.9	154.5	150.9
Glass mfg	152.0	157.6	154.0
Paint mfg	155.2	160.8	157.2
Paper mfg	155.5	161.1	157.5
Petroleum ind	158.3	163.9	160.3
Rubber ind	160.7	166.3	162.7
Process ind. avg	159.2	164.9	161.4
Related Industries			
Elec. power equip	163.5	169.1	165.5
Mining, milling	162.6	168.2	164.6
Refrigerating	173.3	181.2	174.8
Steam power	150.6	156.2	152.6

MOVE OR STORE:

Bulk-Handling Bucket

Cleveland Beacon Products Co., 1930 West 77th St., Cleveland 2, Ohio, has introduced a line of bulk-handling buckets, each designed to meet a specific type of application. The view above shows one type that may be used either in a materials handling system, equipped for monorail or bridge crane transportation, or it can be used in a stationary position. It is also claimed to be suitable for storing, transferring and mixing of bulk materials. The bucket is of all-welded construction, equipped with a bottom slide gate which permits emptying without tilting. An opening on the top allows for hopper or chute filling.

EASY LUBRICATION:

Improved Belt Carrier

Stephens-Adamson Mfg. Co., Aurora, Ill., has announced an improved line of ball-bearing belt conveyor carriers known as Sealmaster. To insure easy running the three idlers are carried on six permanently sealed, prelubricated ball bearings. These may be lubricated if needed at any time in the future from either side of the belt by

(Continued)

a single shot of the lubricant gun. Grease then reaches all bearings through the hollow live shafts. The latter turn with the rollers. The rollers themselves are readily removable without tools. Welded construction eliminates all bolts and the idlers are carried in a rigid one-piece steel frame designed to tilt in the direction of belt travel and thus keep the belt centered without need for guide rollers. The base is of the inverted angle type to shed material and keep the rollers free.

SOUND, NON-POROUS:

Nickel Pressure Castings

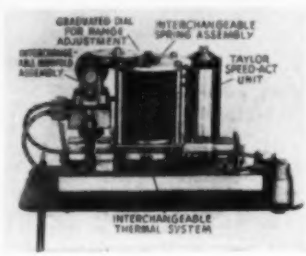
Stainless Foundry & Engineering Co., 5132 North 35th St., Milwaukee 9, Wis., is now producing 99 percent nickel pressure castings, as well as Monel and Inconel castings, in addition to the company's earlier line of stainless steel castings. Although molten nickel has a high affinity for gases, it is claimed these castings are unusually sound and free from porosity. They are reported to machine readily and to be easily fabricated by welding.

ONE-MAN OPERATION:

Portable Unloader

Markrov Co., Sixth and McCambridge Sts., Madison, Ill., has developed a new portable car unloader employing a bucket type elevator of tubular steel construction, in conjunction with a "gravity-assisted" feeder which is readily installed beneath the rails between any two ties whose spread need not be more than 16 in. Excavation is held to a minimum and there is no need to construct a concrete pit beneath the rails. Since the roadbed is undisturbed, the unloader meets railroad requirements. Furthermore, neither the feeder section nor the unloader proper need be moved while cars are being spotted.

The feeder portion contains dual feeder pans for unloading both sides of the hopper car simultaneously. These pans move with an upward and outward thrust through action of an eccentric, and thus accelerate the gravity flow of material. The unloader is readily transported from place to place and requires only one man to operate. It may be powered either with a small air-cooled gasoline engine, or electrically, as desired. The unloading capacity is $1\frac{1}{2}$ to 2 tons per min.

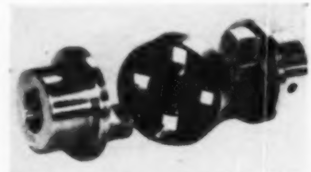


FORCE-BALANCE TYPE:

Pneumatic Transmitter

The Taylor Instrument Cos., Rochester, N. Y., has introduced a new pneumatic temperature transmitter of the force-balance type, to which the name Transaire has been given. The instrument is designed particularly for those applications where indication, recording or controlling of temperatures must be quick and accurate at distances of about 50 ft. or more from the point of measure. The instrument is suitable for temperatures in the range from -375 deg. F. to $+1{,}000$ deg. F., employs a small thermal element, and is said to give exceptionally high speed of response due to the incorporation of a function known as Speed-Act, which applies the principles of derivative action directly to temperature determination.

This function overcomes the lag inherently present in the response of thermal measuring elements. The instrument employs $\frac{1}{4}$ in. O.D. copper tubing to transmit pressure changes which are linear with respect to the temperature measured within 0.1 percent. Distances up to 1,000 ft. between transmitter and recorder are possible. The instrument is compensated for barometric and ambient temperature changes and employs interchangeable unit assemblies so that the over-all operating limits of the instrument can be changed.



RESISTS HIGH TORQUE:

Rubber Flexible Coupling

The Estey Co., 547 North Main St., Canandaigua, N. Y., has introduced a flexible coupling consisting of three elements. It includes two steel flanges for attachment to the connected shafts, carrying lugs with concave surfaces which key with a steel-banded synthetic rubber spider. The latter separates the metal lugs of the flanges and is said to carry the heaviest loads, under the most severe operating conditions, without thrust on the driver or driven machine. The coupling is said to provide for maximum shock absorption, while resisting higher torque. The steel spider ring permits the coupling to operate at high speed without damage or breakdown of the synthetic rubber spider from torque or centrifugal force. The coupling compensates for both parallel and angular misalignment, is completely silent, and requires no lubrication.

FOR DIRTY ATMOSPHERES:

Unit-Cooled Motor

General Electric Co., Schenectady, N. Y., has announced that it is now prepared to supply unit-cooled d.c. motors in ratings up to 200 hp., so de-

(*Continued*)

These 20% stainless steel clad vessels are typical of the type of work done in Pfaudler shops.

Pfaudler to bid on your stainless steel requirements

When you get a Pfaudler bid, you can be sure that the quotation is based on a job that gives you the best results over the long pull. That means engineering and building to high standards. Sure, it's always possible to shave prices by skimping on sound design and workmanship but you pay for it in the long run.

So take a leaf from the book of exacting buyers—people like DuPont, Merck, General Chemical, Hoffman-La-Roche, American Cyanamid and hundreds of others—and ask Pfaudler for a bid on your stainless steel requirements.

You get the benefit of long, diversified engineering experience which results in equipment that produces better yields, for example. Such problems as heat transfer, agitation, drives and finish are important to efficiency. There is no substitute for the right answer.

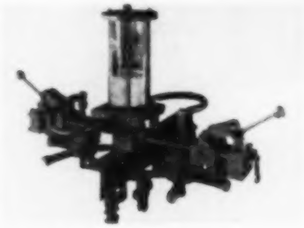
Well-equipped shops and well-trained ASME code fabricators play their part in giving you what is needed to answer your requirements honestly. That's why users tell us that the life-cost ratio of Pfaudler stainless steel equipment is exceptional. It's to your advantage to let us quote on your next stainless steel requirement. Call any one of the offices listed.

Pfaudler

THE PFAUDLER CO., Rochester 3, N. Y. Branch Offices: 330 West 42nd St., New York 18, N. Y.; 111 W. Washington Ave., Chicago 2, Ill.; 1325 Howard St., San Francisco 3, Calif.; 818 Olive St., St. Louis 1, Mo.; 13231 W. McNichols Rd., Detroit 21, Mich.; 1318 1st Nat'l Bank Bldg., Cincinnati 2, O.; 1041 Commercial Trust Bldg., Philadelphia 2, Pa.; 751 Little Bldg., Boston 16, Mass.; 334 Chattanooga Bank Bldg., Chattanooga, Tenn.; P. O. Box 4096, Dallas, Texas; Enamelled Metal Products Corp., Ltd., Artillery House, Artillery Row, London, S. W. 1, England.

THE PFAUDLER CO., ROCHESTER 3, NEW YORK
ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT
Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

signed that they may be operated at slow speeds for long periods of time. The air-to-air heat exchanger functions through two blowers driven by a single Tri-Clad induction motor, so that cooling is independent of motor speed. One blower circulates internal air through the motor and unit cooler, while the other blows external air through the cooler. The new cooling system employs pressed steel sheets which are stacked and welded together at the edges to provide alternate air passages at right angles to each other. Since the motor air never comes in contact with contaminated outside air, these motors may be operated in dusty, dirty or oil-laden atmospheres, and require no piping, duct work, air filters or pressurized air supply.

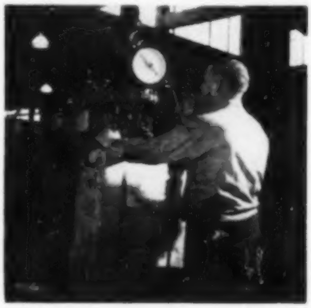


OPERATES AUTOMATICALLY:
Conveyor Grease Lubricator

J. N. Fauver Co., 49 West Hancock St., Detroit 1, Mich., has introduced its Model 304 Lubricator, a self-contained grease-applying device for conveyors of the type employing a series of trolley wheels moved on overhead track by a continuous chain. The lubricator requires no external power for operation and is driven by contact with the trolley wheels. As a wheel approaches the lubricator, the hub engages the sleeve of one of the five pumping units which is thus automatically brought into contact with the wheel bearing. Continued rotation of the lubricator forces the pumping unit inward, delivering a measured quantity of lubricant through the fitting to the wheel bearing. A cam in the pump housing then snaps the lubricator into position for the next wheel as it comes along.

LONG LIFE:
Orlon Filter Cloths

Filtration Engineers, 155 Oraton St., Newark 4, N. J., has introduced, through its filtration fabrics division, a new filter cloth woven from Orlon, Du Pont's new chemical and bacteria resistant synthetic fiber. The new fabric is said to have a high strength-to-weight ratio, even at elevated temperatures, to be excellent for strong mineral acids, common solvents, oils, greases and acid solids. Fabrics are produced in a wide range of weaves, are easy to clean, non-blinding, and will last considerably longer than previously available cotton cloths. They are said to be available for all types of filters.



RUGGED, LIGHT:
Hydraulic Crane Scale

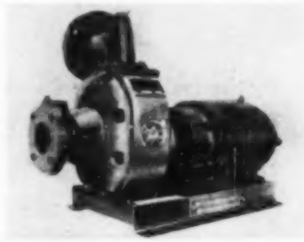
The A. H. Emery Co., Stamford, Conn., is offering a line of hydraulic crane scales which can be hung from the crane hook to support and weigh the load. In many operations weighing time can thus be saved. The crane scale is built in three series, the smallest with a capacity of 10,000 lb., the second 20,000 lb., and the third, 30,000 lb. The smallest size is available in eight dial capacities, in the range from 0 to 10,000 lb. Five dial capacities are produced in the range from 10,000 to 30,000 lb. In each of the three series, dial sizes may be 8½, 12 or 16 in. in diameter.

ADVANCED DESIGN:
Improved Belt Conveyor

Transall, Inc., 109 North 11th St., Birmingham 4, Ala., has introduced an improved belt conveyor unit, designed for minimum height, self-cleaning of the idler rolls, sealed-in lubrication of the anti-friction bearings, and one-shot lubrication of all idlers when lubrication eventually is required. The idlers are individually mounted in neoprene for shock absorption, and the minimum weight frame-work supporting the idlers and return roller are of pressed steel, fabricated by welding and assembled on installation by the use of square-head non-turning bolts. Since the troughing and return idlers are mounted in a single supporting frame-work, the arrangement requires minimum head room and can be as-

(Continued)

sembled with maximum ease. The design is said to result in minimum power consumption, thus permitting maximum center-to-center conveyor length. For installations requiring protective covers, the design is particularly adapted to ready use of half-circle corrugated tunneling which can be carried on the same supports used for carrying the conveyor, thus permitting large savings in total installed cost.



MEET WIDE NEEDS:
Self-Priming Pumps

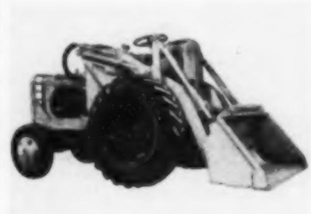
Marlow Pumps, Ridgewood, N. J., has recently expanded its line of self-priming centrifugal pumps to give 26 basic series, each one of which can be modified almost endlessly by combinations of mountings, fittings and materials. The line now includes electric horizontal, long-coupled, and vertical and horizontal close-coupled models, portable and stationary engine-driven models and belt-driven types. All use this company's so-called "diffuser" method of priming which requires no bypass valves or other mechanical devices. These pumps are suitable for a wide variety of liquids including volatile liquids and those containing abrasives in suspension, and will handle viscosities up to 500 S.S.U.

STEPLESS CONTROL:
Motor Speed Changer

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass., has introduced its Type 1700-A Variac speed control for operating a ¼-hp.

(Continued)

d.c. shunt motor from an a.c. line. A constant field voltage is supplied by a dry-disk rectifier, while the armature voltage can be varied by a Variac auto transformer feeding an electronic rectifier. Thus, smooth control is said to be obtained from motor rated speed down to practically zero, with speed regulation constant at all speed settings. Overload capacity for starting is several times full load armature current, with full protection provided by a circuit breaker.



RAPID HANDLING:
Shovel Loader

Tractomotive Corp., Dearfield, Ill., has developed and is marketing through Allis-Chalmers industrial trac-

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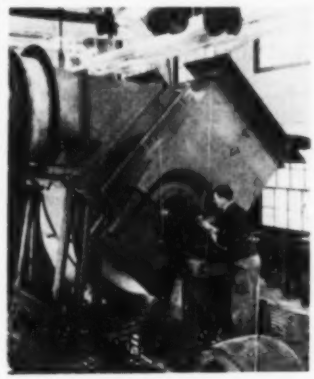
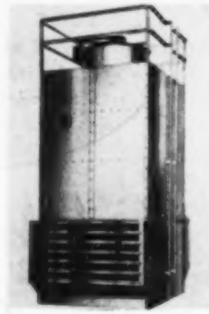


COMPRESSORS FOR BROOKHAVEN

The Sturtevant Division of Westinghouse Electric Corp., Pittsburgh, Pa., has now shipped the centrifugal compressors which will be used to cool the atomic pile at the Brookhaven National Laboratory. One of these is shown here being tested. Each of the 12-ft.-high air movers employs a nine-bladed, 3½-ft. diameter, all-steel wheel driven at 450 mph. top speed by a 1,500-hp. motor.

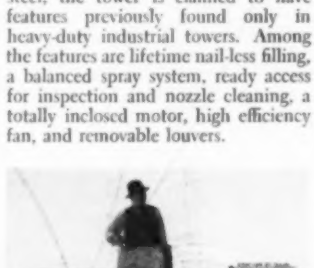
tor dealers, a new ½ cu.yd. materials handling loader known as the TL-W Tracto-Loader. The loader is mounted on rubber tires and has the bucket over the driving wheels and the steering wheels in the rear. The design is said to provide exceptionally good traction and make steering easier, permitting operation in close quarters. The bucket need not be rammed into the material for loading, since it picks up its load through forward crowding action. The bucket has an automatic tiltback feature, is hydraulically operated and positively controlled.



EASILY MAINTAINED:

Standard Cooling Tower

The Marley Co., Kansas City, Kans., has introduced the Verflow, a new standard cooling tower for medium to large capacity requirements, which is said to be easy to erect and simple to maintain. Designed in wood or steel, the tower is claimed to have features previously found only in heavy-duty industrial towers. Among the features are lifetime nail-less filling, a balanced spray system, ready access for inspection and nozzle cleaning, a totally inclosed motor, high efficiency fan, and removable louvers.



EMPHASIZES SAFETY:

Live Roller Conveyor

Standard Conveyor Co., North St. Paul 9, Minn., is offering a number of new conveyors. One of these is a

(*Continued*)

new design of live roller conveyor, in which the roller-actuating transmission consists of a roller chain mounted at one side of the frame, engaging sprockets attached to hexagon through shafts. A chain provides positive driving of the axles, but the rollers may be stopped by a slight pressure of the hand, and if the line becomes filled with material being handled, the bearings simply turn, thus making the rollers stationary. Since there is no belt running beneath the rollers, as is usual with belt-driven live roller conveyors, it is impossible for the operator to get his hand between the roller and the belt. This company has also brought out an aluminum roller conveyor with a capacity of 50 lb. per lineal foot when supported on 10-ft. centers.

DOUBLE CHARGING CAPACITY:
Truck Battery Charger

General Electric Co.'s Lighting and Rectifier Divisions, Schenectady, N. Y., have developed a sequence charge control which can be attached to this company's rectifier type truck battery chargers to double their working capacity. The device makes it possible to charge two fully discharged batteries in 13 hours from a single rectifier. A high starting rate is applied first to one battery to bring it up to 80-90 percent of full charge, then to the second battery. Both batteries are then automatically given the finishing charge simultaneously. However, to charge a single battery in 8 hours the basic characteristics of the original charger are restored by the flick of a switch.

ECONOMICAL CONSTRUCTION:
Glass-Concrete Building

Pittsburgh-Corning Corp. 307 Fourth Ave., Pittsburgh, Pa., has been testing during the past two years, both

(Continued)

ASSETS
not on Balance Sheets

In fifty years a business gathers assets not found on any balance sheet. One we rate at the top is manpower—the selected, trained and tested men of the Bechtel "family" who have moved up through the ranks to positions of leadership.

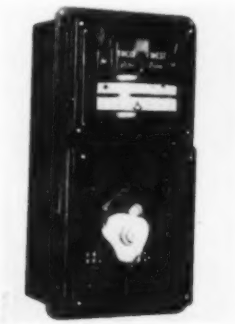
Their combined experience covers all principal fields of engineering and construction. To use it effectively, Bechtel policy makes available for each job the men best qualified by knowledge, special skills and past performance, and backs the project team with headquarters services and centralized responsibility.

BECHTEL CORPORATION

LOS ANGELES · SAN FRANCISCO · NEW YORK

in the United States and in Canada, buildings erected of panels consisting of cellular Foamglas insulation cores, plied with concrete veneers and thus made up into thin, flat, sandwich walls. These walls have been fabricated in several practical sizes and thickness. The most popular thickness is 6 in., consisting of 2 in. of cellular glass core with 2 in. of exterior and interior concrete veneer. This is half as thick as the conventional masonry wall, yet has twice the insulating value.

Panels may be cast at the site, or fabricated miles away and shipped to the point of erection by truck or rail. The largest panels made to date measure 256 sq. ft. Because the panels are thinner, usable floor area is increased about 72 sq. in. for each running foot of floor perimeter. The new construction method is said to be adaptable to all three curtain wall systems, including the spandrel, vertical and bay filling types.



WIDE CONTROL RANGE:

Programming Controller

Taco West Corp., 515 North Noble St., Chicago, Ill., is offering its new Model CPR time-temperature program controller. The upper section of the instrument is a modified Model C Veri-Tron electronic controller of the indicating type, designed to give uniform control level independent of line voltage variations. The lower compartment contains a synchronous motor-driven cam which is readily cut on the job to give the desired temperature cycle. This cam controls the index arm of the Veri-Tron controller. The device is suitable for giving the desired temperature cycle in a wide variety of applications including such diverse industries as ceramic, plastic forming, and chemical synthesis. A wide variety of standard and special scales ranging from -300 to $+3{,}400$ deg. F. (or

(Continued)

centigrade equivalents), are available. The controller end may be of the two-position, multiple-position or proportioning control type.

DESIGNED FOR SAFETY:
High Pressure Gage

United States Gauge Div., American Machine and Metals, Inc., Sellersville, Pa., has introduced a high-pressure gage for use in the manufacture of ammonia, hydrogen, nitrogen, and other high-pressure gases, and in chemical and mechanical research, in which maximum protection is assured the user. The gage is cast with a solid wall integral with the case to separate the bourdon tube and movement section from the observer. The entire back of the case is fitted with a spring-mounted safety release which, in the event of bourdon tube rupture, will momentarily discharge the high pressure medium away from the observer. The tubes are of specially selected beryllium copper or stainless steel, attached to the socket and tip by threads and sealed against a specially designed cone of hardened, polished stainless. Accuracy is claimed to be 1 percent of full scale for pressures up to 50,000 psi. and 2 percent of full scale for pressures of 60,000 psi. and over.

Briefs

MULTIPLE METER. Brooks Rotameter Co., Lansdale, Pa., is offering a multi-tube rotameter which can be built with two or more rotameter tubes for use on related flows. The device consists of a group of this company's standard Full-View rotameter end fittings fastened to a metal back plate, with the front of the unit shielded with a plastic window. Each tube may be removed individually without disturbing the other parts.

FILTER CLOTH. Michigan Wire Cloth Co., 2100 Howard St., Detroit 16, Mich., has developed its Specification 8700 metal filter cloth

(Continued)

which comes from a five-year research program sponsored by the company at the University of Michigan and the Detroit Testing Laboratory. The cloth is currently produced in Monel metal and Chromel C, and is woven to order in various other alloys, including stainless steel and high nickel alloys. The cloth is said to be particularly applicable when both fine straining action and free-flowing qualities are essential.

VERSATILE HOSE. Goodyear Tire & Rubber Co., Akron, Ohio, has announced a new all-purpose hose known as Ortac for carrying air, water, oil, gasoline and acids of low concentration and temperature. The hose uses a vertically braided rayon carcass, combined with oil resistant synthetic rubber for inner tube, friction and cover. Sizes range from $\frac{3}{16}$ to $1\frac{1}{2}$ in. inside diameter.

PLASTIC TAPE. Polyken, Dept. F, 222 West Adams St., Chicago, Ill., is offering Polyken No. 822, a plastic backed electrical adhesive tape, with a dielectric strength of over 10,000 volts, which has been developed by Bauer & Black. The new tape has the insulation and electrical characteristics of its parent material, polyethylene. It is said to be ten times more resistant to moisture than vinyl tapes.

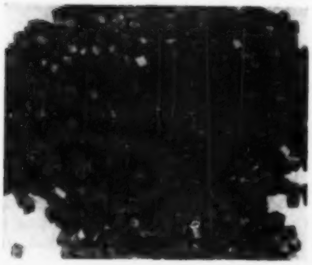
MIXING VALVE. Ansul Chemical Co., Marienette, Wis., is offering a specially designed, all-stainless steel valve for mixing liquid or gaseous sulphur dioxide and water. The water inlet and outlet are standard 1-in. pipe thread, and the sulphur dioxide inlet $\frac{3}{4}$-in. pipe thread. The valve is being employed successfully, it is said, in paper and other industries.

GLASS THERMOMETER. United States Gauge Div., Sellersville, Pa., has announced a glass tube type refrigerator thermometer with a flexible copper connecting tube running to the temperature-responsive bulb. It is thus possible to install the instrument in a wide variety of places without the risk of breaking the tube in installation. Available ranges are from −50 to +300 deg. F.

INDUSTRIAL FOOTWEAR. Hood Rubber Co., Div. of B. F. Goodrich, Watertown, Mass., is offering a new line of industrial rubber footwear made of a special-purpose rubber having extremely high resistance to chemicals. Boots are made without seams or joints and several different types of footwear tested in chemical plants and refineries are said to have given superior service. —*End*

New Products and Materials

JOSEPH A. O'CONNOR, Assistant Editor



Contents

CUBICAL:

Plastic Extrusion Compounds

B. F. Goodrich Chemical Co., 324 Rose Building, Cleveland 15, Ohio, manufacturers of Geon polyvinyl chloride resins, plastics and latices, have started the manufacture of certain Geon plastic extrusion compounds in uniform cubical form. Field tests show that the cubical form offers users improved uniformity and better quality control of their products. Geon plastics are plasticized polyvinyl chloride resin compounds sold in ready-to-use form for extrusion, calendering and molding.

In the wire and cable industry the new cubical granules are expected to increase considerably the efficiency of the extrusion operation and the quality of vinyl insulation. More even and complete heating of Geon plastic is made possible during extrusion because of uniform cubical size. Porosity sometimes caused by the entrapped air in non-uniform granules is minimized.

The improved plastics are the result of a new method of granulation recently developed by Goodrich engineers. They will be offered for sale at no added cost.

STABLE SALT:

Potassium Dicyanoguanidine

American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y., announces the availability of potassium dicyanoguanidine in experimental quantities. This compound should be of interest to the chemical industry because of its recent origin. It was first described in the literature in 1945, and many of its reactions remain to be investigated. The product is a stable salt which can be readily converted to the free acid or to other salts.

Dicyanoguanidine can be isolated as a crystalline solid which is unstable upon storage. It is readily soluble in water, and its acid strength is comparable to that of hydrochloric acid. Reactions which have been investigated include the formation of substituted melamines by the action of amines and the formation of ammeline by treatment with hydrochloric acid.

ANTIBIOTIC:

Neomycin

Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn 6, N. Y., is pushing results to determine the effectiveness of Neomycin in halting tuberculosis.

So far the work has been confined to test-tube experiments and tests on laboratory animals.

Results of these tests carried out by Pfizer researchers indicate that Neomycin is capable of exerting an antimicrobial effect against both gram positive and gram negative microorganisms, as well as against streptomycin-sensitive and streptomycin-resistant strains of *M. tuberculosis*. The frequency with which organisms resistant to the action of streptomycin emerge during therapy is one of the major drawbacks to the use of streptomycin in the treatment of tuberculosis.

Studies in lower animals indicate the Neomycin probably possesses a low degree of toxicity. It is highly effective in protecting animals against infections due to such organisms as *K. pneumoniae, E. typhosa* and *Proteus vulgaris*; furthermore, preliminary studies indicate that it is capable of suppressing experimental tuberculosis infections in mice.

According to the Pfizer investigators, it is too early to interpret the effect of Neomycin on experimental human tuberculosis. The results obtained in animals are, however, suggestive. If the results reported can be reproduced in humans, Neomycin may prove an effective agent in the treatment of many forms of tuberculosis, particularly those forms in which the organisms have become resistant to streptomycin.

FOR PROTECTIVE COATINGS:

Octoic Driers

Witco Chemical Co., 47 Ann St., New York 7, N. Y., is now in commercial production of a complete new line of driers to be marketed under the name Witco Octoic Driers. The new driers are metallic soap solutions in a petroleum solvent, and they are made from 2-ethyl hexoic acid, which is also known as octoic acid.

The new driers are of uniform composition. Since they are made from a synthetic acid of definite chemical composition, their metal content is always retained. The driers are lighter in color than the corresponding naphthenic acid driers. Their viscosity is less than A on the Gardner-Holdt scale, providing easier handling and mixing. Odor of the soap is negligible. The stability of the drier solution is outstanding; there is no precipitation or sludging. Compatibility and solubility are excellent, the driers being easily dispersible with oils, varnishes, resin solutions and paints. Drying power is equal to or better than that of the naphthenate type of drier. The solids content is lower than that of the naphthenates, which means less extraneous matter is added to the formulation.

The unusual effectiveness of Witco Octoic Driers is particularly noticeable under adverse drying conditions of high humidity. Since their metallic soaps have no odor, they are preferable for use in printing inks, sanitary enamels and other products where freedom from odor is desired. In fact, they can be substituted in almost all formulations calling for

(Continued)

naphthenate type driers, which are likewise manufactured by Witco.

Another new drier—Witco 6% Iron Naphthenate—also represents an advance in this field due to its excellent stability, clarity and solubility. Sludging is eliminated. This new product will find considerable application in baked enamels and varnishes, foundry core oils and composition wallboard binders.

Technical service reports on all these products may be obtained from Witco.

FOR COATINGS:

Polythene Resins

E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., is now producing commercial quantities of a new series of polythene resins for use as coating materials. They have been given the trademark Alathon. So far, their biggest use has been as coatings by paper manufacturers and converters.

The Alathon polythene resins are closely related to the Du Pont plastic, polythene. They are highly resistant to chemicals. They have excellent electrical insulating properties at high as well as low frequencies. They are tasteless, odorless and non-toxic. They are not only waterproof, but have a very low rate of vapor permeability.

Alathon polythene resins are essentially unaffected by long exposure to concentrated sulphuric, nitric, hydrochloric, hydrofluoric or acetic acids at room temperature. The resins are fairly resistant to oxidizing agents such as chromic acid or acid permanganate solutions. Other of their distinguishing characteristics are their insolubility at room temperature and their excellent resistance to vegetable and animal oils at ordinary temperatures. The resins are slightly soluble in vegetable oils at 200 deg. F. or above.

Outstanding physical characteristic of these resins is their lightness. In appearance they are white, waxy and translucent. Mechanically, they range from hard, brittle, waxlike materials to tough, flexible compositions.

The resins give papers a brilliance approaching that of a lacquer finish. The new coatings also are harder, somewhat tougher and non-sticky. In addition, their grease resistance is considerably improved and their heat-seal strengths are made slightly better.

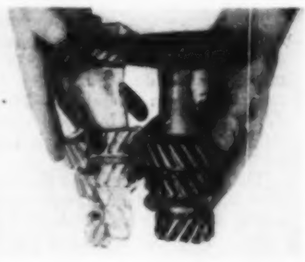
As coatings for paper, the Alathon series lend the properties of the resins to the paper. Thus they make it resistant to chemicals, water, water vapor, and cooking oils and greases, while, at the same time, giving it toughness and strength without imparting taste or odor or making the paper sticky.

Papers coated with Alathon can be used to particular advantage as packaging for materials that are acid or corrosive in nature; or that contain animal or vegetable fats and oils; or that must be protected from moisture; or kept from drying out; or kept at a high degree of chemical purity.

Because the flexible types of Alathon polythene resins retain flexibility at sub-zero temperatures, papers coated with them offer obvious advantages as frozen food packages, or for the protection of machinery and equipment at low temperatures. At the other extreme, Alathon-coated papers, because of their resistance to moisture, will protect electrical apparatus and other equipment against corrosion and fungi during storage under hot, humid conditions.

Fertilizers and fertilizer ingredients, calcium chloride, solid caustic soda, sodium phosphates, magnesia, silica gel, synthetic detergents, resins, humus and portland cement can all be shipped in containers made from Alathon-treated papers. Bags and packages can be made from papers coated with Alathon by a simple heat-sealing process.

Du Pont is producing commercially four Alathon resins—A, B, C and D. Their molecular weights range from 18,000 or 19,000 for Alathon A to 8,000 or 9,000 for Alathon D. All of the resins may be applied by commercial methods.



STRIPPABLE:

Hot-Melt Coating

Western Coating Co., 85 West Union St., Pasadena 1, Calif., has developed a hot-melt strippable protective coating that prevents rust, corrosion and abrasion. Salt water and salt air have no effect upon parts so treated. Coated parts show no evidence of rust after being subjected to 100 deg. F. and 100 percent humidity for 30 days. These coated parts will

(Continued)

withstand temperatures ranging from −40 deg. F. to 160 deg. F. A special rust preventive concentrate gives double protection.

Westcoat-Clear, as the coating is called, is extremely tough, having a tensile strength of 990 psi. It has a fire point of 455 deg. F. Nearly water-white, Westcoat-Clear is highly resistant to darkening in the tank. Since numbers and writing on the part can easily be read through the coating, no further labeling is necessary. The coating can be re-melted and used over and over again, as long as it is not contaminated. The melt compound comes in clear form, but Western can also furnish separate color dyes. When used, these dyes give deep colors without disturbing the transparency. Often different colors can be used to facilitate the identification of coated parts.

Westcoat-Clear conforms to Army Ordnance Specification JAN-C-149. It also conforms to Army-Navy Aeronautical Specification AN-C-117b.

In use, the compound is heated in a tank to about 350 deg. F., at which temperature it becomes molten. The metal part to be coated is then dipped into this molten material for about 10 sec. and allowed to air-dry. A strong waterproof abrasion- and corrosion-resistant film 0.1 in. thick forms and hardens in less than 60 sec. The part can then be handled, shipped or stored.

In a simple and single operation the part is completely protected. Packaging costs and manpower required are reduced. When the need for protection is past, the coating is e ily removed by slitting with a knife and pulling it off in one piece.

Westcoat-Clear can be used to protect finished products when they are packed for shipment. It also gives added sales appeal to products. In addition, it can be used to protect tools, dies, gages and all sharp cutting edges from corrosion and abrasion in tool rooms. It can also be used to coat gears, threads, camshafts, spark plugs, axle shafts, intake and exhaust valves, and both open and sealed bearings.

STYMIES FUNGI:

Copper Fungicide

Engineer Research and Development Laboratories, Fort Belvoir, Va., has developed a new copper fungicide for incorporation in paint and other protective coatings. Copper 8-quinolinolate, the new commercial product just now reaching the chemical market in quantity, may, in the opinion of

(Continued)

Army Engineer researchers, revolutionize the paint and protective coating industry. In particular, the new chemical is helping to solve some knotty problems confronting the Corps of Engineers in protecting both structural materials and fabrics against fungus attack in the tropics.

Discovery of the new family of versatile fungicides came as the climax of six years of research by a group of ERDL scientists. This research was conducted to develop a paint that would protect the Army's equipment in tropical areas.

A yellow-green compound, copper 8-quinolinolate, came to light in routine ERDL experiments that tested more than 500 common or possible fungicides. Formed from a reaction between 8-hydroxyquinoline and copper acetate, the compound is heat stable and insoluble.

It can be used in its original form as part of the pigment in paints. During the ERDL tests, common "red barn" paint containing copper 8 and a control sample of the same paint containing no fungicide were exposed on identical wooden slabs for a period of three months to the ravages of heat, moisture and the fungus-laden air in the tropical testing chamber.

At the conclusion of the test, the treated sample showed no visible deterioration; by contrast, the control sample of paint showed more than 95 percent destruction, with heavy fungus attack on the wood beneath.

Going beyond the paint discovery to seek a process for combining the insoluble powder in a form suitable for fabric impregnation, ERDL technicians mixed it with naphthenic acid and copper naphthenate, itself an excellent fabric preservative. This mixture, when cooked, produced a dark viscous fluid—nicknamed "gunk"—which can be thinned with common commercial toluene and used like any of the less potent fungicides for impregnation of fabrics.

Results of the "gunk" tests surpassed the expectations of the fungus control experts. Copper 8 seems to be as effective in fabrics as in paints. The favorable results point to a development of great significance to the Army and all other users of canvas, web and burlap goods that need protection against fungus contamination.

Yellow-green color of the new fungicide—as first discovered—might dismay users of light-colored paints. It is no problem, of course, in the Army's traditional olive drab. As a promise for the future, continuing research at ERDL has developed a similar and

(Continued)

Just as the continual dripping of water wears away the hardest stone, so does the softest textile fiber wear away thread guides of the hardest metal. So scientists have sought longer-wearing materials for these tiny guides over which endless miles of thread are drawn at tremendous speeds in textile mills.

Working in the field of ceramics, researchers at American Lava Corporation found that by using a mix consisting principally of ALCOA Alumina, they could produce thread guides which would set new wear performance records.

Today thousands of thread guides, made of this unique material, known as "Alsimag"* 491, are reducing manufacturing costs throughout the textile industry—especially where the processing of fibers or filaments reduced the life of ordinary guides.

This is a typical example of how ALCOA Chemicals are used to make products better and reduce manufacturing costs. If aluminas or fluorides have any application in your business, let us tell you more about those sold under the "ALCOA" trade-mark. More and more, they are being used to improve the quality of *successful* products. Write to: Aluminum Company of America, Chemicals Division, 1778 Gulf Building, Pittsburgh 19, Pa.

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equally effective fungicide with a more adaptable hue.

At the outset, ERDL scientists had assumed that the 8-quinolinol nucleus of the copper 8 molecule was the true fungicide. The 8-quinolinol nucleus is produced, along with copper ions, as a result of the enzymatic action of the fungus itself. But research showed that (1) the microganisms destroy 8-quinolinol unless the copper ions are present, and (2) 8-quinolinol is not a fungicide in itself except when used in high concentrations.

Research continued with the assumption that any copper salt present with 8-quinolinol might be effective in inhibiting fungus growth. This assumption proved true. Only slight variations in potency have been noted in compounds using all the copper salts so tested to date.

Further basic research may use radioactive isotopes as tracers to determine whether the copper is acting as an enzyme poison and thus preventing the chemical properties of 8-quinolinol from being destroyed.

DUAL CHARACTER:

Substituted Diols

Carbide & Carbon Chemicals Corp. 30 East 42nd St., New York 17, N. Y., has achieved the initial synthesis of two new glycols. These latest additions to the large family of glycols offered by Carbide may be characterized as glycols and at the same time glycol-ethers. They may also be considered as mono-alkyl ethers of a trihydric alcohol. Their complete chemical names are 2-methoxymethyl-2,4-dimethyl pentanediol-1,5 and 2-ethoxymethyl-2,4-dimethyl pentanediol-1,5.

All hydroxyl groups are primary. Because the alcohol groups are primary and are separated by five carbon atoms, these compounds are substituted 1,5-pentanediols.

These pentanediols combine the chemical characteristics of glycols and glycol-ethers. The two hydroxyl groups in the 1,5 positions make them of special interest for the manufacture of maleic and other alkyd resins, plasticizers and elastomers. Combination of alcohol and ether groups in the same molecule confers unusual solubility and coupling characteristics which make them useful as coupling agents and as solvents for protective coatings, hydraulic fluids, duplicating fluids, metal cleaners, textile dyes and adhesives.

The water solubility and low volatility of these diols suggest their use as

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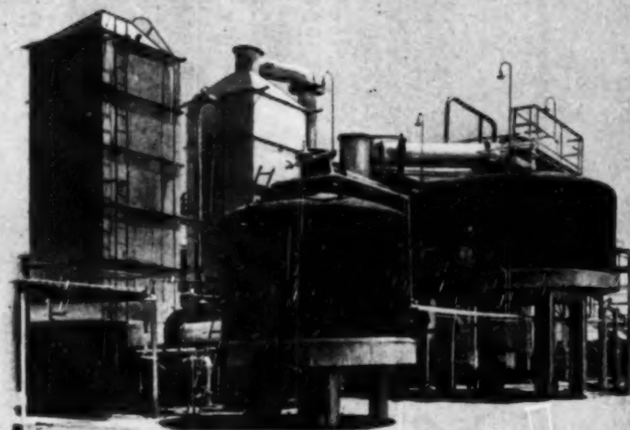

softeners or plasticizers for casein, zein, and other water-soluble resins.

The methoxy compound, when used at concentrations between 15 and 25 percent by weight based on the total resin composition, is an effective plasticizer in the milling, molding and casting of such polyamide resins as nylon. The finished articles possess better flexibility, increased toughness and higher impact resistance, especially at low temperatures. The methoxy compound is completely soluble in water.

On the other hand, the ethoxy derivative possesses very limited solubility in water, thus suggesting its value as an intermediate for plasticizers and resins that would be expected to have excellent water resistance.

These diols are currently available in sufficient quantity for laboratory investigation. Orders for 5 gal. or less will be billed at $3 a lb. fob. South Charleston, W. Va. By October 1949 commercial production of these two materials will be under way, permitting a selling price of less than $1 a lb. Samples and additional technical data can be secured from Carbide.

ANTI-ANEMIA:

Vitamin B_{12}

Merck & Co., Inc., Rahway, N. J., is now marketing crystalline vitamin B_{12}, used to treat pernicious anemia. Isolation of the new vitamin, which will be called Cobione, was announced last spring by five Merck scientists.

Cobione is the first vitamin known to contain the metal cobalt.

Cobione now is produced through fermentation. Last December five Merck scientists reported the successful isolation of crystalline vitamin B_{12} from a mold. This mold, a strain of *Streptomyces griseus*, belongs to the same species as that which produces streptomycin, the drug used so successfully in the treatment of tuberculosis and other infections.

Cobione is so potent that extremely small doses have given immediate relief to critically ill patients. The anti-pernicious anemia activity of Cobione is more than a million times greater than that of whole liver.

Use of vitamin B_{12} results in a rapid increase in red blood cells and hemoglobin, and quickly re-establishes the capacity of the bone marrow to produce new red blood cells in pernicious anemia patients. At the same time, the patient has an increased sense of well-being, greater mental alertness, an enhanced strength and vigor. Those pernicious anemia patients who have

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developed nerve symptoms have also been greatly benefited. In addition, vitamin B_{12} has been used successfully in cases of nutritional anemia and sprue, a disease found chiefly in the tropics.

Clinically, the use of Cobione will permit physicians to administer exact doses of the pure vitamin and thus accurately control treatment. Potent doses may be given with virtually no physical discomfort to the patient, as the vitamin is active in such infinitesimal amounts. It has also been found that Cobione may be given without discomfort to patients who are allergic to liver.

Cobione is being marketed in ampules for administration by physicians. Each ampule contains 10 micrograms of crystalline vitamin B_{12} in saline solution. Initially, supplies may not be sufficient for the entire medical profession. Because of the clinical importance of vitamin B_{12}, however, Merck will make every effort to release adequate supplies of the new vitamin through regular distribution channels as quickly as production allows.

FOR TUBERCULOSIS:

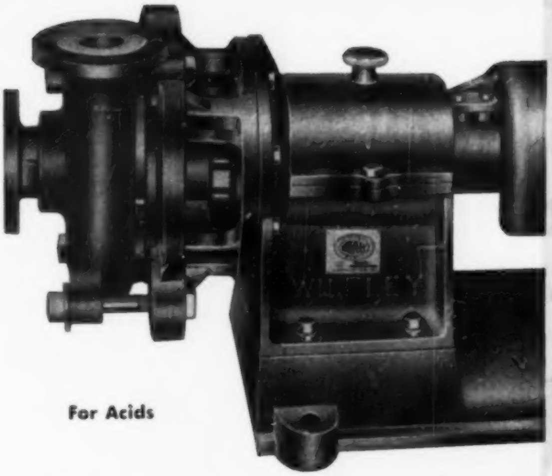
Para Amino Salicylic Acid

Monsanto Chemical Co., St. Louis 4, Mo., is now turning out in commercial quantities for the pharmaceutical industries a chemical which, in combination with other drugs, has shown promise as a cure for some types of tuberculosis. The chemical, para amino salicylic acid, commonly known as PAS, is one of the few compounds showing positive properties against tuberculosis.

Results of experiments conducted mostly in Europe, but also in the United States, have been encouraging, although the number of total clinical tests is not yet sufficient to draw positive conclusions. PAS has been tested on both animals and humans, but seems most effective with streptomycin.

Nature of tuberculosis makes it extremely difficult to obtain accurate clinical results. The only sure method seems to be to treat a great many cases and observe them over long periods of time. Large amounts of pure PAS are needed adequately to conduct these experiments.

With large amounts of PAS available, it will be possible for pharmacologists and clinicians to investigate its action further, particularly in conjunction with other drugs, such as streptomycin and dihydrostreptomycin. However, Monsanto emphasizes the caution that PAS alone is not the final answer. —*End*



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Handling, Packaging and Shipping

R. W. LAHEY, Editorial Consultant

Bureau of Explosives Reports on 1948

From the 1948 report of the Bureau of Explosives, we again have concrete evidence of the magnificent job performed by this organization. We, in the chemical industry, have come to accept as a matter of course the effective and cooperative work of the bureau. Without publicity of any kind they advise shippers and the many regulatory agencies of safe transportation and handling practices for dangerous products.

Of the 639,000,000 lb. of commercial explosives produced and shipped in 1948 there was a total property loss of only $9,834 of which $8,000 was caused by a fire involving military smoke devices. Of greater significance is the fact that there were no injuries nor any fatalities incurred in the rail transportation of this large quantity of explosives.

In the transportation of all dangerous articles other than explosives and petroleum products the loss for the year totalled $583,018. Of this loss $265,000 was due to negligence of employees in draining a tank carload of poisonous liquid into a stream, thereby killing a herd of cattle which used the stream as a watering place. Twenty-four persons were injured as a result of these accidents as compared with 34 injuries in 1947.

The bureau, in cooperation with the Board of Transport Commissioners for Canada has prepared uniform regulations for both countries. This uniformity should benefit railroads as well as shippers in both countries and will provide a greater degree of safety.

The report should be read. Everyone in the chemical field should be familiar with this record of accomplishment. High praise is due to Chief Inspector Harry A. Campbell and his competent staff.

New Committee Will Advise Munitions Board

Albert B. Drake, American Warehousemen's Association, was elected chairman at the first meeting of the Munitions Board Packaging, Storage, and Materials Handling Industry Advisory Committee which was held in Washington in May. Task subcommittees on training, warehousing, materials handling, refrigerator warehousing, stevedoring and packaging were appointed by the committee.

Chief among the problems on which the committee will be expected to advise the munitions board and the military services are development of military warehousing, packaging and storage practices of the latest commercial techniques and coordination of these practices with efficient materials handling practices.

Explosives by Air—New Regulations

The Civil Aeronautics Board, on May 20 adopted regulations covering transportation of explosives and other dangerous articles which became effective on July 20. These regulations include rules for both passenger and cargo planes.

In general, the packing, marking, and labeling requirements for air transportation follow the ICC regulations for rail express shipments. Certain changes are required because of wider temperature ranges and the effect of altitude on certain types of packaging.

H.R. 3940, an enabling act to give these regulations legal status, is now before the House Committee on Interstate and Foreign Commerce. This proposed law will make the shipper responsible for compliance with these requirements.

Cost Reduction to Feature Packaging Meeting

The eleventh annual forum of the Packaging Institute will be held at the Hotel Commodore on October 24-26. Although the program has not been announced it will spotlight the need for cost reduction as well as changes in packaging of consumer goods resulting from current competitive markets. An example is the growing demand for small sizes at the expense of the larger packages. Fruit and vegetable prepackagers have been invited to take part in this forum.

ASTM Adhesives Committee Invites Participation

An invitation to those interested in adhesives to attend future meetings and participate in the work of Committee D-14 on Adhesives, of the American Society for Testing Materials, was extended by this group at the spring meeting held at the Hotel Stevens in Chicago.

(Continued)

PALLETS ON PORTABLE RACKS

Portable racks (made by Equipment Manufacturing Co., Detroit) are used for stacking palletized materials. Rack underclearances can be adjusted to varying heights of pallet loads. Removable extension posts are used for high stacking.

Embracing the entire field of adhesives, the committee membership consists of 32 consumers, 36 producers and 17 general interest members. It is the feeling of the committee that a diversification of membership, reflecting as broad a range of adhesive applications as possible, would facilitate committee work and more accurately determine industry practice.

Development and approval of several tentative standard test methods has already been achieved. A series of definitions of terms has been standardized. Work on additional procedures, methods, specifications and other objectives of the committee is progressing. Next committee meeting is scheduled for October in Philadelphia.

The subcommittee structure of ASTM Committee D-14 is arranged according to: (I) Strength Tests; (II) Analytical Tests; (III) Tests for Permanency; (IV) Working Qualities; (V) Specifications; (VI) Nomenclature and Definitions; (VII) Research Problems; and (VIII) Electrical Properties of Adhesives.

Information and details concerning the activities of the committee can be obtained from George W. Koehn, Research Laboratories, Armstrong Cork Co., Lancaster, Pa.; J. H. Wills, Philadelphia Quartz Co., 121 South Third St., Philadelphia 6, Pa.; or from the ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

Regulation Proposed in Massachusetts

An act has been introduced into the Legislature of the State of Massachusetts which will require labelling of chemical substances harmful to the health of industrial workers. It names specifically benzene and carbon tetrachloride and 20 percent mixtures of these compounds.

What's a Materials Handling Engineer?

At the Materials Handling Exposition last January, T. L. Carter of American Cyanamid Co., discussed the qualifications needed for successful work in materials handling engineering. His several years of experience in this field qualify him as a specialist well able to express himself on this subject. A summary of his remarks:

Materials handling engineering requires not one specialized skill but rather a general knowledge of the many skills needed to cover all handling methods with the ability to coordinate all related functions. He

(Continued)

For men who work with heat or cold

"Armstrong's Insulator" is a bimonthly magazine published by the Armstrong Cork Company as a service to men who work with high, medium, and low temperatures. Much of the editorial material contained in the "Insulator" is developed from Armstrong's work in the solution of problems involving the use of insulations to control heat and cold.

The list at the right of this page will give you an idea of the variety of subjects discussed in recent issues. Some were comprehensive reports on an entire industry or a new method of using heat or cold. Others were engineering articles, outlining with facts and drawings the technical details of good insulation practice.

If you would like to read any of these articles, we will be glad to send you the copies of "Armstrong's Insulator" in which they appeared. Just write to Armstrong Cork Company, 3308 Maple Avenue, Lancaster, Pennsylvania.

ARTICLES FROM RECENT ISSUES OF "ARMSTRONG'S INSULATOR"

LOW TEMPERATURE

Synthetic Fiber Manufacture
Fur Farm Cold Rooms
The Meat Industry
Eyeglass Lens Production
Seed Storage
Tomato Ripening and Storage
Railroad Car Freezer
Freezers on Trawlers
Manufacture of Insulin
Hotel Chefs' Kitchens
One Story Bakery Design

LOW-TEMPERATURE EQUIPMENT

Refrigerated Display Cases
Automaton Selling
The House Trailer Industry
What's Happening in Refrigerators
Medical Storage Cabinets
Dry Ice for Trailer Routes
Ice Cream Trucks

HEAT INSULATION

Insulation of Steam Traced Lines
Piping of Hot Viscous Fluids
Steel Mill By-Products
Central Station Steam
Cork as A Heat Insulation
Should Hot Flanges Be Insulated
Insulating Dual Purpose Lines

INSULATING REFRACTORIES

Designs for Home Pottery Kilns
Enamelling Furnaces for Lustron Homes
Soaking Pit Dampers
Controlled Atmosphere Furnaces

CONSTRUCTION AND MAINTENANCE

Converting Coolers to Freezers
Refrigeration Losses Through Freezer Doors
Floor Drain Constructions
Temporary Erection of Insulation
Cold Room Tracking
Right and Wrong Insulated Construction
Ventilation under Freezers

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service
For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

PACKAGING, *cont. . .*

should have a varied engineering experience, know the importance of proper maintenance, have an intimate knowledge of the design of structures and have actually designed equipment. Engineering, supplemented by production experience, is most desirable.

Next in importance to engineering ability is his knowledge of available handling equipment—how they operate and what they are capable of doing.

To supplement these fundamentals, some knowledge of warehousing, traffic, containers, safety and labor relations is important. Methods of engineering including time study are helpful in the solution of most materials handling problems.

A man with these qualifications is well equipped to handle the varied materials handling problems that are encountered in a large manufacturing company. His varied experience should provide the needed broadness of vision required for this work.

Can-Testing Research

Research, as conducted at Maywood, Ill., laboratory of American Can Co., is directed at the solution of problems involving metal cans for packaging household and industrial products. Tests to determine the optimum performance of materials used in fabricating these containers, including caps and liners, are conducted with the actual product. Can sealing compound tests are immersed and subjected to the vapor phase of the product. Results are sometimes obtained by chemical analysis and by use of the spectrophotometer.

Laboratory tests are usually supplemented by trial packing runs in the customers plant assisted by this research group.

Technologists in packing operations can assist in planning and setting up packing lines.

Tin Control Eased

The U. S. Department of Commerce has relaxed conservation orders M-43 and M-81 which control industrial uses of tin. Special coated manufacturing terneplate and 0.25-lb. tinplate may now be used to fabricate cans to be used for packing any product. All hand soldered cans, drawn necks and nozzles, and soldered parts of all 5-gal. square cans may be fabricated from 0.50 lb. tinplate. Wider use of pig and secondary tin is also authorized in collapsible tubes. The tin content in solders for general use is increased.

(Continued)

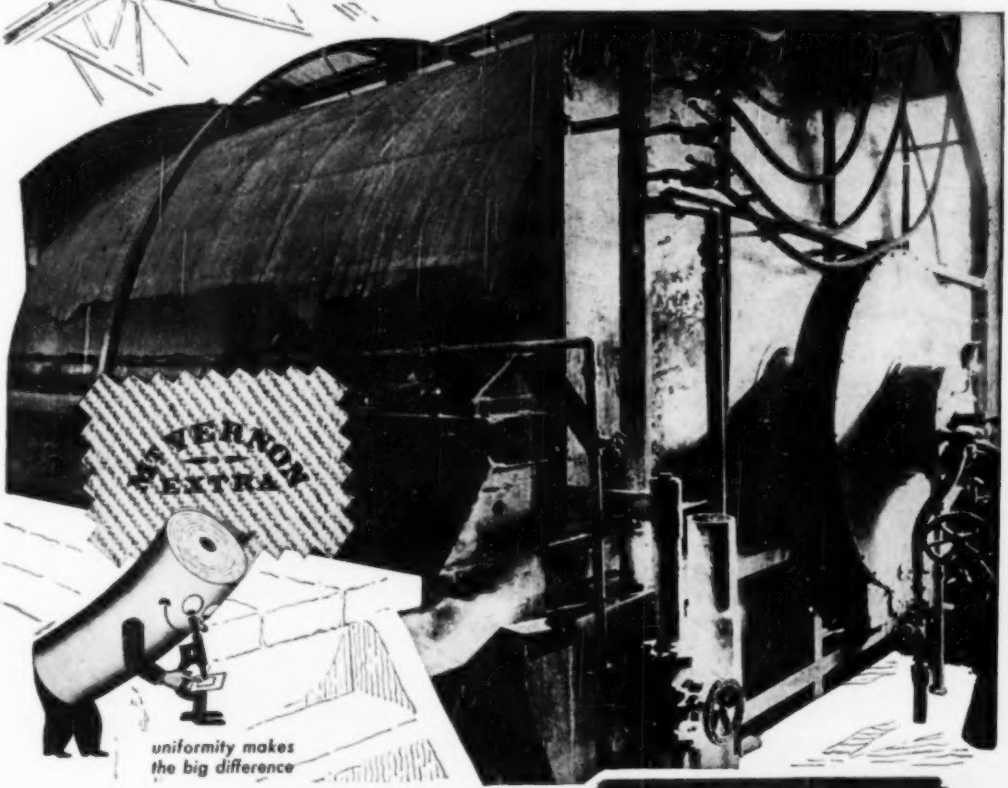
Uniformly Better Filtering with Mt. Vernon Extra

Mt. Vernon Extra filter fabrics are made from top grades of cotton and produced under rigid laboratory controls . . .

The result is Mt. Vernon Extra's high degree of uniformity—for more thorough filtering—greater clarification of filtrates—more efficient recovery of solids . . .

Mt. Vernon Extra has the ruggedness required to take the rough scrubbing and scraping that's necessary in filter-fabric cleaning . . .

For fabrics that give you more thorough, more efficient filtering and longer wear, specify Mt. Vernon Extra.



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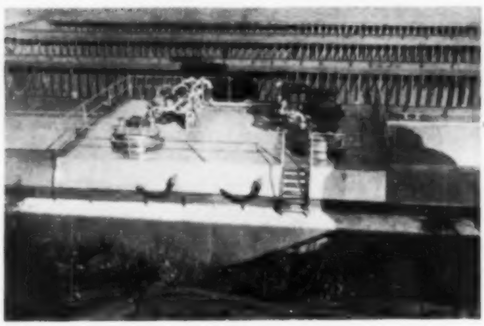
New Muriatic Barge Fleet Is Born

CHASSIS LAUNCHED

Five new barges specifically designed for transportation of HCl from Freeport, Tex., to Cincinnati have been placed in service by Dow Chemical Co. These vessels, of welded steel construction, are strengthened for use in the Intracoastal Waterway. They will be ready when the . . .

TANKS ARRIVE

Four tanks, each of 58,400 gal., make total capacity 233,600 gal. [Earlier barges of six tanks had a total of 216,000 gal. (*Chem. Eng.* June 1949, p. 191).] Constructed of welded steel, they have been rubber lined by the B. F. Goodrich Co. Assembly is completed with . . .



FITTINGS INSTALLED

A working platform for loading and unloading is built around the dome of the tanks. It is designed so that any spilled acid will drain overboard. Sand and tar deck coating, railing and stairs to the deck protect safety of the workmen. Now the barge is ready for its . . .

TRIAL RUN

The barges, designed by Dow engineers and Dravo Corp. naval architects, are 195 ft. long, 35 ft. wide and 11 ft. deep. They are easy to tow, having a 30 ft. bow rake and a deep transom stern. They are painted a bright vermillion with blue-green trim and lettering. —End

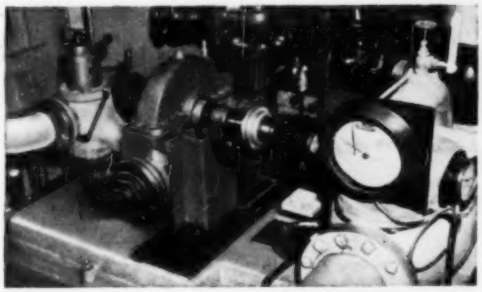
TURBINE TIPS

no. 2

question: When is turbine power really a bargain? . . .

answer:

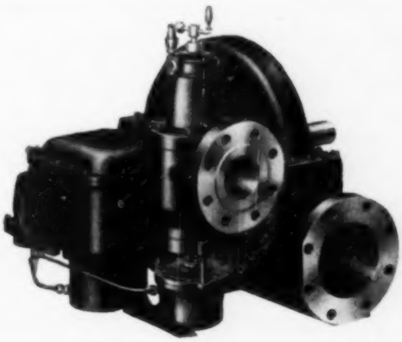
When low-pressure steam (5 to 100 lb) is needed for process requirements such as heating, drying, cooking; or for service requirements such as building heating, feed-water heating, etc. For instance, this turbine installation uses boiler steam to drive a centrifugal pump, then exhausts low-pressure steam for heating use. The turbine only takes a small portion of the heat from the steam—from 10 to 20 per cent—leaving the balance for other use. Thus the mechanical power produced is almost free.



question: When is a turbine a bargain? . . .

answer:

When the design embodies many outstanding features—all in a standard machine at standard price. Take, for instance, a turbine like G-E's standard Type DP. The DP incorporates many features of larger "special" designs—wide range hydraulic governing, pressure lubrication, balanced valves, and many others. Yet, thanks to superior design and greater standardization, these features are all yours at no extra cost.

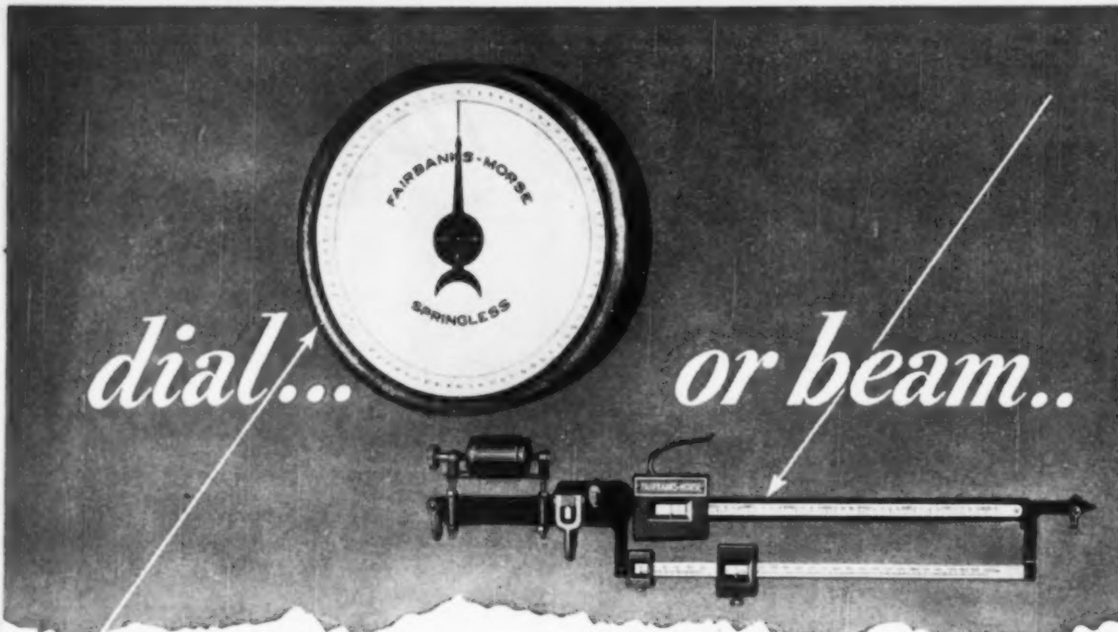


question: Where can I "get the facts" when considering a turbine application? . . .

answer:

Just call or write the nearest G-E Apparatus Sales Office. Your G-E sales engineer will gladly give you complete data on the application of turbines to your mechanical drives—and full information on the many outstanding features *standardized* in G-E turbines. *Apparatus Department, General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC



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For all weighing operations, there is a Fairbanks-Morse Scale that exactly suits your requirements. Whether it is a Dial Scale or a Beam Scale, accuracy ... fast operation ... ease of reading ... long service ... are built-in Fairbanks-Morse advantages that provide the easy way to "weigh."

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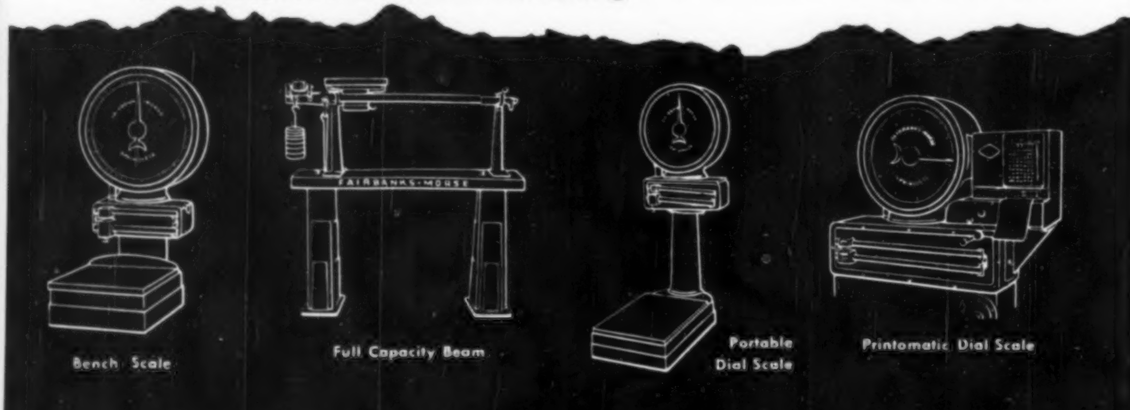
MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR
CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS



Men, Machines and Methods

ROGER WILLIAMS, JR., Assistant Editor

Wide World

Attorney General Clark

"to the breaking up"

Hans Knopf, PIX

President Greenewalt

"no real understanding"

Du Pont-GM Antitrust Suit May Tell Whether Bigness in Business is Bad; Will Not Answer How Big is Big

Is big business bad? That is what the Antitrust Division of the Department of Justice seems to be trying to find out. It appears to be the basis for the antitrust suit aimed at Du Pont, General Motors and U. S. Rubber. Whether or not this suit will answer the question is in doubt. In any event, it cannot answer a much bigger question:

If bigness is bad, how big is big?

The antitrust suit against Du Pont has all sorts of interesting facets to it, facets that were not discussed in the newspapers when the indictment broke into print. For one thing, few if any of the newspapers gave the background of why Du Pont holds 10,000,000 shares of General Motors common stock.

Back in the second decade of this century the automobile business was just getting started. Many an automobile company started up and then folded. General Motors was having its troubles, was faced with bankruptcy. The only answer seemed to be to float more common stock. The catch was that investors were shying away from automotive stocks; too many companies were failing. So they started looking for an industrial investor.

At the same time, Du Pont had accumulated a fair amount of cash which it wanted to invest. More than that, General Motors, small as it was then, was a pretty good customer of Du Pont. What was more natural than that the two get together. They did, with John J. Raskob as the "getter-together." The net result was the investment that the government is suing about now.

At the time of the investment, Pierre du Pont told the stockholders, "While there is no immediate relation between the explosives industry and the manufacture of motors, this investment was made in such a way as to give opportunity for our financial organization to be of service, and at the same time increase greatly our financial strength."

This, then, was the start of the present suit.

If this stock ownership were the only thing back of the suit, it would have caused less interest than it has. Du Pont President Crawford Greenewalt highlighted the interest when he said, "the motive for this suit must arise out of a determination by the Department of Justice to attack bigness in business as such."

There have been many things said about big business, some good, some bad. One of the things that those who are against size must remember is that bigness in business is a natural result of our economic development.

As the world has developed scientifically, the world of the individual has expanded tremendously. It used to take days to ride from Philadelphia to New York, say, weeks to go from New York to Chicago. Then the train came along and cut the latter trip to days and finally to overnight. Then the airplane made it a matter of hours. What this has meant is that the area the individual knows and travels in has expanded.

In the same way, trading areas of businesses have expanded. Today's manufacturer of shoes, let us say, would hardly be content to supply only his own township. To compete he must also sell in the nearby city, and eventually in other cities. With today's methods of transportation, almost all businesses in the manufacturing field operate nationwide, and most worldwide.

To handle any business on a nationwide basis you have to have a big organization, a big company. And the more successfully you operate your business, the bigger you have to become.

But there is another reason why companies have grown large—the type of manufacturing that is necessary today to maintain and improve our standard of living. When articles were handmade, there was little need for large investments. Today's mass production requires huge investments in equipment to produce large quantities of products at low cost.

BIG BUSINESS DEVELOPS

Perhaps one thing worth looking at is what companies are the giants of today's manufacturing economy, and how they have developed. Few people realize that most of today's biggest companies are in the CPI (chemical process industries). They are the "blue chips" of United States industry.

The National City Bank of New York recently published a table

(*Continued*)

Five decades of growth show great changes in the line-up of America's 25 largest

1900	1910	1920	1930
Federal Steel Co.	U. S. Steel Corp.	U. S. Steel Corp.	U. S. Steel Corp.
U. S. Leather Co.	Standard Oil Co. (1906)	Stand. Oil Co. (N. J.)	Stand. Oil Co. (N. J.)
Amer. Steel & Wire Co.	American Tobacco Co.	Armour & Co.	General Motors Corp.
Amer. Sugar Ref. Co.	Inter. Harvester Co.	Swift & Co.	Bethlehem Steel Corp.
Continental Tob. Co.	Amalgamated Cop. Co.	General Motors Corp.	Anaconda Cop. Min. Co.
National Tube Co.	Central Leather Co.	Bethlehem Steel Corp.	Ford Motor Co.
American Tobacco Co.	Pullman Company	Ford Motor Co.	Stand. Oil Co. of N. Y.
Am. Smelt. & Ref. Co.	Armour & Co.	U. S. Rubber Co.	Stand. Oil Co. (Ind.)
National Steel Co.	Amer. Sugar Ref. Co.	Stand. Oil Co. of N. Y.	Gulf Oil Corp.
Amer. Car & Fdy. Co.	U. S. Rubber Co.	Midvale Steel & Ord. Co.	Shell Union Oil Corp.
American Woolen Co.	Am. Smelt. & Ref. Co.	General Elec. Co.	Texas Corp.
National Biscuit Co.	Swift & Co.	Inter. Harvester Co.	Stand. Oil Co. of Calif.
Internat. Paper Co.	General Electric Co.	Sinclair Con. Oil Corp.	E. I. du Pont de N.&Co.
Republic In. & St. Co.	Corn Prod. Ref. Co.	Texas Company	General Electric Co.
Amer. Tin Plate Co.	Amer. Car & Fdy. Co.	Anaconda Cop. Min. Co.	Armour & Co.
Glucose Sugar Ref. Co.	American Can Co.	Phelps Dodge Corp.	Sinclair Con. Oil Corp.
Amer. Writ. Paper Co.	Lackawanna Steel Co.	E. I. du Pont de N.&Co.	Allied Chem.&Dye Corp.
Amer. Steel Hoop Co.	American Woolen Co.	Gulf Oil Corp.	Inter. Harvester Co.
Am. Hide & Lea. Co.	West. Elec. & Mfg. Co.	Am. Smelt. & Ref. Co.	Western Electric Co.
Swift & Co.	E. I. duPont Powd. Co.	American Tobacco Co.	Union Oil Co. of Calif.
Ten. C., I. & R.R. Co.	Republic In. & St. Co.	Transcont. Oil Co.	Kennecott Cop. Corp.
National Lead Co.	Va.-Car. Chem. Co.	Magnolia Petrol. Co.	Inter. Paper Co.
General Electric Co.	Internat. Paper Co.	B. F. Goodrich Co.	Pullman, Inc.
Union Bag & Pap. Co.	Bethlehem Steel Corp.	Stand. Oil Co. of Calif.	Un. Carb. & Car. Corp.
Rubber Gds. Mfg. Co.	Amer. Locomotive Co.	Pullman Company	Swift & Co.

Basis: Total assets. Source: National City Bank of New York.

(shown here) of the 25 largest manufacturing corporations in the U. S. for each of the decade years of the century and the beginning of 1949. The growth of CPI companies into their dominant position today is graphically illustrated by the table.

The growth of Du Pont, Antitrust's current target, is impressive. Back at the turn of the century it was not listed. By 1910, it was 20th with total assets of $75 million. Ten years later it was the 17th biggest manufacturing company. By 1930, depression and all, it was 13th. Nine years ago, Du Pont rated fifth and today it is fourth with total assets of $1.6 billion.

This impressive growth is a tribute to the men who have managed Du Pont, a tribute to the dynamic growth of the chemical industry. But it is also a reason why the Antitrust Division kept its eye on such a company.

DuPont is not the only CPI company that bulks large in the table. No less than three of the biggest five manufacturing companies in the United States are in CPI (including Du Pont). So are four of the next five.

OIL COMPANIES BIG TOO

As might be expected, the dominant companies in this group are petroleum companies. No less than ten of the top 25 companies are in the petroleum business. Top company on the list is Standard Oil Co. (N. J.) with over $3.5 billion in total assets. It is interesting to note that in 1900 not a single oil company was listed, and only one (the old Standard Oil Co. of 1906) was on the list in 1910—although it was the second biggest in the country.

Petroleum companies, like many chemical companies, just have to be big to get the economy the public demands. Eugene Holman, president of Standard Oil Co. (N. J.) wrote last year in the American Magazine, "There are some things the large corporation can do more efficiently. The large company can bring off undertakings that would bankrupt the small operator long before they began to show a profit. For instance, Jersey Standard's affiliate in Venezuela had to invest some $30,000,000 and spend nearly 10 years developing oil regions in Eastern Venezuela before the first oil was shipped out commercially."

Du Pont, too, has been fighting the idea that big business is bad—has been fighting the idea for years. Last summer at Chattanooga Henry B. du Pont said:

"We have here a partnership composed of big companies on the one hand and small businesses on the other. If this partnership is not permitted to function in a normal manner, the entire industrial system will be seriously undermined. Big and Little Business make progress together, not one at the expense of the other.

"It may seem strange that anyone should seriously question this obvious truth, yet it is a fact that there are Americans who, in their distrust of Big Business, would risk seeing our whole industrial system destroyed. There is an inclination on the part of many to accept at face value every charge that 'Big' Business is, by nature, intent on the elimination of 'Small' Business. I believe they feel this way because they simply do not have the information on which to reach a proper understanding of how business operates. Because of this thinking, there is a trend in the United States to restrict large business organizations; to make it difficult for them to accumulate the earnings that have made their growth possible. We see alarming tendencies on the part of the courts to find something inherently wrong in 'Bigness' itself. And, this

manufacturing corporations.

1940	1949
Stand. Oil Co. (N. J.)	Stand. Oil Co. (N. J.)
U. S. Steel Corp.	General Motors Corp.
General Motors Corp.	U. S. Steel Corp.
Socony-Vac. Oil Co.	E. I. du Pont de N.&Co.
E. I. du Pont de N.&Co.	Stand. Oil Co. (Ind.)
Bethlehem Steel Corp.	Socony-Vac. Oil Co.
Stand. Oil Co. (Ind.)	Texas Company
Ford Motor Co.	Gulf Oil Corp.
Texas Corp.	General Electric Co.
Stand. Oil Co. of Calif.	Stand. Oil Co. of Calif.
Anaconda Cop. Min. Co.	Bethlehem Steel Corp.
Gulf Oil Corp.	Ford Motor Co. (1948)
Allied Chem.&Dye Corp.	Cities Service Co.
Inter. Harvester Co.	Western Electric Co.
Shell Union Oil Corp.	Un. Carbide & Car. Corp.
General Electric Co.	Sinclair Oil Corp.
Republic Steel Corp.	Westingh. Elec. Corp.
Kennecott Cop. Corp.	American Tobacco Co.
Consolidated Oil Corp.	Inter. Harvester Co.
Un. Carbide & Car. Corp.	Anaconda Cop. Min. Co.
Swift & Co.	Shell Union Oil Corp.
Armour & Co.	Allied Chem.&Dye Corp.
American Tobacco Co.	Phillips Petroleum Co.
Western Electric Co.	Kennecott Cop. Corp.
Aluminum Co. of Am.	Chrysler Corporation

factor is a major one in alleged violation of our antitrust laws. We see taxes set at levels that discourage investment.

"No, there is nothing incompatible or antagonistic between Big and Little Business. The mutuality of their interests is fundamental to the American competitive system.

"If we permit ourselves to be confused and adopt national policies which will tend to throttle American business progress, we will be well started down the road toward the totalitarian goal, which appears to make sure that no man shall be rich. For myself, I believe we should devote ourselves to preserving in the United States our incentive economy—which strives to the end that no man shall be poor."

DU PONT FAVORITE TARGET

Du Pont has been a target of the Antitrust Division many times in recent years. Since 1935 there have been five civil actions and ten criminal actions against Du Pont, not counting the new GM-Du Pont civil action.

Of the civil actions, four charged a variety of practices in restraint of trade, and one—the Cellophane Case—charged monopoly. Four of the civil actions are still pending. They are the GM, Cellophane, Imperial Chemicals Industry, and Bendix (brake fluid) cases—the companies named being codefendents with Du Pont. In the ICI case restraint of trade is charged and in the Bendix case restraint of trade and monopoly. Two of the civil cases ended with decrees against Du Pont, one a consent decree and the other a decree entered after trial.

Two of the ten criminal cases are still pending and in both of them Du Pont has entered pleas of not guilty. They are paint cases, in one of which Du Pont is the defendent.

(Continued)

MM&M, *cont...*

In the other Sherwin Williams is codefendent. The charge in each case is price fixing.

Two of the criminal actions ended with dismissal of the indictments prior to trial. In one case—involving Du Pont and Rohm & Haas over prices of methyl methacrylate for denture plates— Du Pont was acquitted by a jury. Seven of the criminal cases have ended with Du Pont entering pleas of *nolo contendere* and the payment of fines. These were four acid cases, titanium dioxide, explosives, and dyestuffs. All these were restraint of trade cases.

Note that practically none of these suits, possibly excepting the Cellophane case, are concerned with size.

What the result of this new suit will be cannot be guessed. But it should be watched by chemists and chemical engineers, because any decision which limits the size of companies might affect many a CPI company. As we pointed out above, the biggest blue chips are in CPI.

But even if the court does decide that bigness is bad, it probably won't answer the $64 question: How big is big?

It Can Happen Here!

Remember last month's story about good public relations, and more particularly about good relations with the press? Maybe it sounded naive. But here is an actual example from the July 15 issue of the New York Sun:

FATAL PIPELINE BLAST

> West Chester, Pa., July 15 (A. P.)—An explosion on the Big Inch pipe line today killed one youth and injured two others.
>
> Dead was Lewis (Pete) Keller, 21-year-old athlete from West Chester who planned to enter Duke University this fall. The injured were Donald Ciccarone, 17, of West Chester, and Ezekiel Taylor, 22, of Alicia, Ark. Ciccarone is in serious condition. Taylor suffered burns about the eyes.
>
> The Texas Eastland Transmission Corporation, which operates the natural gas pipe line, shooed reporters off the scene of the blast at nearby Eagle, Pa., and declined to make public the cause of the blast.

The above is almost a duplicate of what we held up last month as a horrible example. TETC officials should remember Point 2 of last month: "Evasion or side-stepping of the questions put by newspapermen tends only to create the belief that we have something we wish to hide."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Chemical Engineering News

RICHARD F. WARREN, *Assistant Editor*

These eight scrubbing towers at Monsanto, Tenn., keep fluorine from getting out into the air at one of the largest phosphorus plants in the world.

Monsanto Completes Large Fluorine Scrubbing Unit

One of the largest phosphorus plants in the world has added a fluorine scrubbing unit to its operations. Monsanto's Tennessee plan recently completed the erection of the new project several months ahead of schedule. The addition was built to eliminate any possible contribution by the plant's effluents to the presence of fluorosis in or near the plant site. Monsanto is also co-sponsoring (with Victor Chemical) a large-scale research project at the University of Tennessee to determine causes of fluorosis in livestock.

The new addition is a washing unit to eliminate fluorine gas present in smoke emitted from the plant. Gases from the sintering plant are scrubbed with a liquid spray, which absorbs the fluorine, at the rate of 3,000 gpm. The scrubbing system works on 200,000 cfm. of air. Since the air is heavily laden with dust, packed tower types of scrubbing were not usable.

The operation is carried out in eight scrubbing towers. Each is 50 ft. high and 12½ ft. in diameter. The process is known as a non-effluent waste disposal system since no neutralized fluorine is permitted to escape into the air or flow into rivers or streams. Due to impurities in the gas stream, the scrubbed out calcium fluoride is not in a usable form. The fluorine in the resulting liquor is neutralized with a lime solution, forming an insoluble calcium fluoride precipitate which is impounded in a specially built disposal area. Monsanto does not use or sell the material.

The unit resulted from long and extensive research by Monsanto's phosphate division research and engineering departments. Pilot plant studies leading to its installation were directed by B. G. Klugh, a phosphate division engineer. The washing unit was designed by division engineers directed by W. T. Durrett.

Phillips Doubles Output Of Ammonia Plant

Additional facilities have been added by the Phillips Chemical Co., subsidiary of Phillips Petroleum Co., to its Cactus anhydrous ammonia plant near Etter, Tex. Shortage of ammonia used in the production of fertilizers, and plans for expansion of other plants prompted the move. Previous capacity of 70,000 tons a year is to be doubled to 140,000 tons to meet the increased demands. The Cactus plant supplies ammonia to the Phillips Chemical Co.'s ammonium sulphate fertilizer plan at Port Adams, Tex.

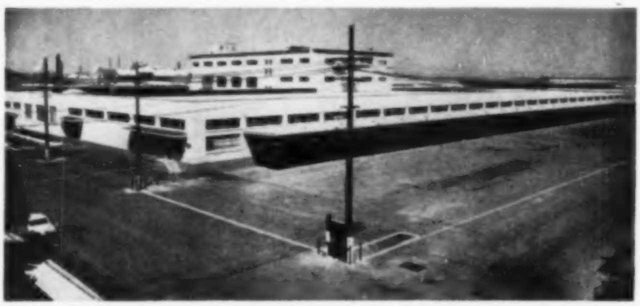
It will also supply ammonia to an ammonium nitrate fertilizer plant now

(*Continued*)

ALDEHYDES FROM NATURAL GAS

The first shipment of acetaldehyde, methanol and formaldehyde made from natural gas left the new McCarthy Chemical Co. plant in Winnie, Tex., recently. The gas had previously been wasted or burned in flares throughout the South Texas area, after conventional petroleum products had been extracted. The McCarthy plant uses the remaining dry gas for making chemicals. Residual gas is then piped to surrounding residential and commercial consumers. Among those present at the time of shipment were (left to right) Glenn McCarthy, president; Henry Haley, plant engineer; and W. P. Doucet, process engineer.

under construction in the vicinity of Etter. This plant is expected to be in operation late in 1949 and will have a production capacity of about 100,000 tons of solid ammonium nitrate a year Phillips officials reported. In addition to the fertilizer, the plant will turn out large quantities of ammonium nitrate solutions. Facilities for production of nitric acid for this plant are also under way. They are located adjacent to the Cactus ammonium plant.



Automatic controls run this new packaging unit at California Standard's Richmond refinery. Products range from pharmaceuticals to heaviest greases.

SOCAL Opens New Grease Unit At Richmond

At Richmond and Bakersfield, Standard Oil Co. of California is pushing a multi-million dollar modernization and enlargement program. A large plant involving grease production and packaging of several types of lubricants has been put into operation at Richmond.

After the war, Standard Oil set to work to modernize its grease and specialty-manufacturing and package filling-and-handling facilities in its Richmond refinery. Grand objective: reduce costs and improve the product quantity.

Recently, Standard has put into operation the largest grease manufacturing plant on the West Coast, a plant containing processing features that are unusual in the field. A full line of more than 200 greases, primarily those of the calcium, sodium and aluminum base types, is made. Production capacity depends on the type of grease made—it runs well over 20 million pounds per year. If products other than greases are included, the annual figure is between 35 and 40 million pounds.

The plant features automatic controls. Automatic weighing devices, and preset, volumetric metering equipment predominate. These facilities permit a high degree of control over quantities of raw materials entering into processing equipment and quality of the finished products.

The grease plant has 30 mixers. A feature of these machines is the use of variable speed agitators.

Also noteworthy is the use of air-driven motors actuating gear pumps that convey grease from mixers to containers. This system makes possible the flow of grease at controlled and widely variable rates to accommodate the various container sizes.

Equipment for handling of materials is present on a large scale in the 7.5-acre installation. Indicative of the magnitude of the operations is the use of a mile of roller conveyors. Drums are handled at the rate of one every 3 sec. with the use of electronic controls to railroad spurs, truck loading areas and to storage. On eight railroad spurs, the plant can accommodate as many as 32 box cars at once. In the warehouse section, packages are handled in modern methods employing pallets, fork trucks, tractors and trailers. About 20 mi. of piping is used in the installation.

California Creates State Water-Pollution Agency

After a hot fight in the legislature last June, a compromise bill was adopted to coordinate management of all water pollution agencies in the state of California. The issue has been seething for the past two years since the legislature, aroused by increasing contamination of both ground and surface water by growing industries and municipalities, appointed a committee to study the problem.

The committee report concluded that existing state controls were not coping with the situation. Future expansion of industry and population, it indicated, demanded immediate improvement of the water supply. Assemblyman, R. F. Dickey, chairman of the committee, proposed a bill plac-

ing control of contamination abatement in nine regional boards with a state advisory board. Opposition from the governor and a group of cities, counties and water agencies demanded a more centralized control by the state.

In the bills finally adopted, final power will rest in the hands of the state, and local boards will supervise local problems. It will be the responsibility of local boards to: (1) Administer prevention and abatement regulations; (2) encourage self-policing waste disposal plans; (3) establish long-range plans and policies; (4) report to the state board and the local health offices any case of contamination that is not being corrected; (5) establish waste disposal requirements to be met by any new industry or establishment planning to discharge sewage or industrial waste.

The state board will coordinate state-wide policy and clamp down on violators reported by regional agencies. It will also administer state projects and financial aid for pollution control.

Local boards will include farmers, businessmen and officials of local government and water supply organizations. The state board appointed by the governor will include, besides those found on regional boards, the state directors of public health, natural resources, and agriculture, the state engineer, and representatives of public sewage disposal interests.

Uncle Sam Creates a New Purchase Office

General Services Administration is the formal name of the new organization created on June 30, 1949, to coordinate federal purchases for all departments and agencies. Included in this new organization, probably to be known as GSA within the near future, are the Bureau of Federal Supply (formerly Procurement Division) of Treasury Department, the Federal Works Agency and all functions thereof (including Public Buildings Administration and Public Roads Administration), the National Archives, and War Assets Administration.

Jess Larson was named acting administrator by President Truman. Mr. Larson formerly was administrator of Federal Works Agency.

First major accomplishment in the government reorganization recommended by the Hoover Commission, millions of dollars are expected to be saved through more economic methods of federal buying. In addition to the authorized redistribution of functions of all the agencies which were grouped together to make this new GSA, a study looking toward the issu-

(Continued)

ance of detailed standards to guide government procurement officers has been ordered by President Truman.

Those who need the details of organization set forth in the new law should get copies of Public Law 152, 81st Congress, approved June 30, 1949; and Federal Register for July 6, 1949.

National Lead Forms New Department

National Lead Co. has formed a new department to handle specifications for various products, test methods and other standards. The specifications department will be under the direction of Carlton H. Rose.

An integrated system of specifications and methods of test will be established for company products and for the raw materials used in company plants. These will be prepared in cooperation with the branches or divisions whose products or materials are involved.

The new department will be in a

(Continued)

CONVENTION CALENDAR

United Nations Scientific Conference on the Conservation and Utilization of Resources, Lake Success, N. Y., August 17-September 6.

American Institute of Chemical Engineers, regional meeting, Mount Royal Hotel, Montreal, September 6-8.

American Chemical Society, 116th national meeting, Atlantic City, N. J., September 18-23.

American Society of Mechanical Engineers, petroleum division, engineering conference, Oklahoma Biltmore Hotel, Oklahoma City, October 2-5.

American Gas Association, annual convention, Chicago, October 17-21.

Packaging Institute, annual forum, Commodore Hotel, New York, October 24-26.

Technical Association of the Pulp and Paper Industry, engineering conference, Statler Hotel, Boston, October 21-November 3.

Second Pacific Chemical Exposition and Industrial Conferences, Civic Auditorium, San Francisco, November 1-5.

22nd Exposition of Chemical Industries, Grand Central Palace, New York, November 28-December 3.

American Institute of Chemical Engineers, annual meeting, William Penn Hotel, Pittsburgh, Pa., December 4-7.

First Plant Maintenance Show, Auditorium, Cleveland, January 16-19.

Dress up your bulk shipments in

Decorated LEVERPAK DRUMS

choice of (17) colors . . . choice of (14) inks

NOW YOU CAN deliver your dry bulk products in style—make them part of your package "family"... traveling billboards through all stages of use and reuse.

Continental can supply you with improved Leverpak drums in any of seventeen eye-catching colors. We can reproduce your name and trademark in any of fourteen different inks. And there's no waiting for this service. We're set up to start the drums rolling your way as soon as you give us the word.

LEVERPAKS—unpainted or in colors—are the best-looking, most serviceable fibre shipping drums we have ever turned out. They load compactly and ride safely. The patented locking device is easy to open, easy to close. Metal chimes are flash butt welded for greater strength.

If you want a sturdier container . . . one that will "dress up" your bulk shipments, contact our nearest office for full details on Leverpak and other Continental drums.

CONTINENTAL CAN COMPANY

Paper Converting Division • Fibre Drum Section

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NEWS, *cont. . .*

position to serve as a liaison in specification matters between the company and specification-writing bodies, as close contact will be maintained with these groups and technical societies.

An up-to-date library of specifications and test methods issued by government bodies, technical societies and corporations will be maintained to inform branches and divisions of new specifications and revisions.

More Polyethylene From New Carbide Unit

Increased facilities for polyethylene resins output are in operation says Bakelite Corp. According to George C. Miller, vice president, "these new production facilities will more than double the amount of this plastic raw material that has been in extremely short supply since being made commercially available late in 1942."

The new production facilities are located at South Charleston, W. Va., and are operated by Carbide and Carbon Chemicals Corp., another unit of Union Carbide and Carbon Corp.

According to Mr. Miller, "when the rated capacity of the new facilities is reached in the very near future, the production of polyethylene for the entire industry will reach approximately 50,000,000 lb. per year, as compared with about 15,000,000 lb. last year."

Industrial Alcohol Regulations Changed

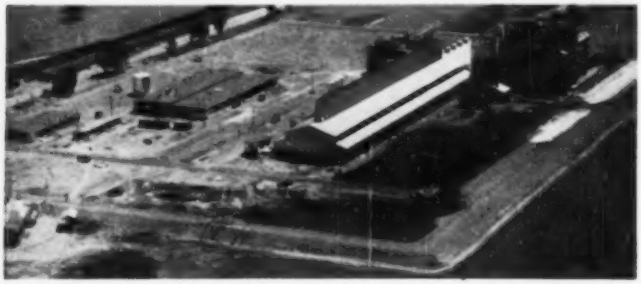
Many changes have been made by Treasury Department's Bureau of Internal Revenue in regard to regulations for those handling industrial alcohol. This includes even those who use specially denatured alcohol, as well as bonded dealers and users of tax-free alcohol. Chemical plants which produce alcohol as a byproduct are also included in the amended regulations. Detailed instructions for handling of alcohol in its various containers, and while in transit or in storage, will be found in the eight pages of the July 8 Federal Register beginning with page 3774.

ISA to Hold Conference In September

Kiel Auditorium, St. Louis, is to be the site of the Fourth National Instrument Conference sponsored by the Instrument Society of America on Sept. 12-16. Twenty-six sessions on various types of instrumentation will hear 75 papers read. Co-sponsors with

(Continued)

the ISA are the National Telemetering Forum, the American Institute of Physics, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The conference is to be held in conjunction with an instrument exhibit featuring the products of 131 exhibitors.



CARBORUNDUM for the growing West will be produced in Carborundum Co.'s brand new push-button controlled plant at Vancouver, Wash. Nearness to resources, market and electric power prompted the move.

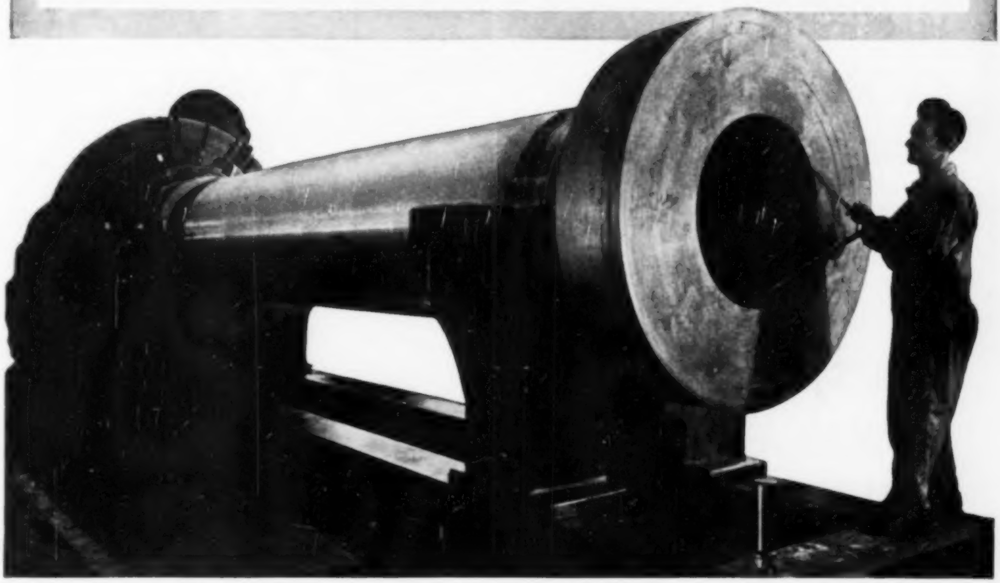
Carborundum Opens Western Plant

Silicon carbide will now be made on the West Coast, close to the growing needs of western industries. The Carborundum Co. of Niagara Falls, N. Y. opened its brand new plant at Vancouver, Wash. The plant has the additional advantage of being near to raw materials and abundant electric power. All equipment is fully automatic, electrically operated and push-button controlled to permit maximum efficiency and freedom from dust in operation.

The mix building, at the center of the plant, stores raw materials in its high towers. Then materials flow by gravity down through the weigher to

(Continued)

When BETHLEHEM Builds Your Pressure Vessel ...IT'S RIGHT!



Forged high-pressure vessels have long been a Bethlehem specialty, and we have built a great many of them over the years. It is a point of pride that our customers entrust us again and again with this work—a strong indication, we feel, that Bethlehem pressure vessels are built *right.*

Bethlehem has all the materials and facilities to do your job 100 per cent—from the making of the carbon or alloy steel to the testing and inspection of the finished unit. Each forged vessel produced in our shops is rugged, durable, seamless. The job is delivered completely or partially machined, whichever you specify.

Your inquiries are cordially invited. They will receive prompt attention from our technical men, who will be glad to work closely with you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

the mixer on the ground floor. In this way, a continuous flow of materials is possible.

The furnace building, largest at the plant, houses batteries of large silicon carbide electric furnaces heated by giant electrodes placed at each end of the furnaces. Mixed raw materials (silica, carbon, sawdust and salt) are brought to the furnaces in cranes. The intense heat generated forms silicon carbide from the mixture, which collects in dense brightly-colored rings of crystals in the core of the furnace. The rings are cooled, broken up, and loaded into buckets to be delivered to jaw crushers, which prepare the product for shipment.

The Nicholson Co., Inc., and the chemical plants division of Blaw-Knox Construction Co. did the engineering and construction of the plant under the direction of L. J. Call of Carborundum. The plant, only the first of many that Carborundum hopes to build in Vancouver, will be staffed by, among others, H. C. Heeld, works manager; J. L. Bergman, plant superintendent; A. C. Knapp, plant engineer; and E. E. Einhorn, office manager.

Electrochemical Society To Meet in Chicago

The ninety-sixth convention of the Electrochemical Society will be held on October 12-15 at the La Salle Hotel, Chicago, Ill. Symposia are scheduled on electrodeposition, corrosion, and organic electrochemistry. Special round-table sessions are being scheduled on batteries and organic electrochemistry. Further information may be obtained from Henry B. Linford, Secretary, 235 West 102nd St., New York 25, N. Y.

Chemical Firms Contribute To Better Industrial Health

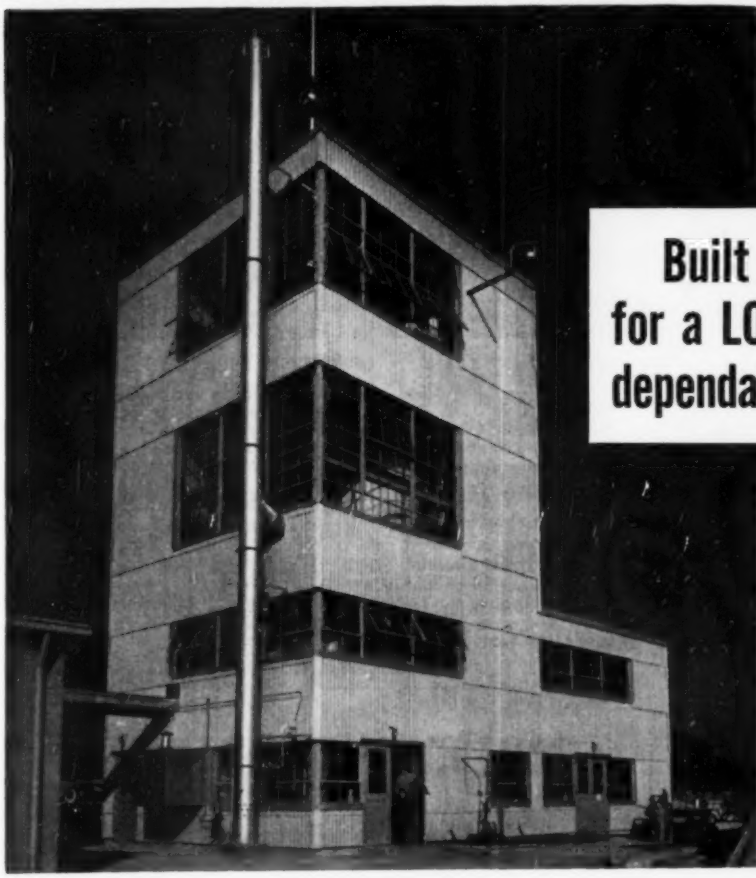
On the College of Medicine campus of the University of Cincinnati is a new $500,000 addition. It houses the noted Kettering Laboratory of Applied Physiology. The addition will double the size of the laboratory.

The original structure, completed in 1930, was erected with funds provided the University by the General Motors Corp., through its Frigidaire Division; E. I. du Pont de Nemours & Co., Wilmington, Del., and the Ethyl Gasoline Corp., now the Ethyl Corp., New York.

The three corporations which made possible the original laboratory were joined later by other industrial organi-

(Continued)

• *New pilot plant of Pittsburgh Consolidation Coal Company at Library, Pa., sided with "Century" Asbestos Corrugated. Construction by Chemical Plants Division of Blaw-Knox Company, Contractors.*



Built for a LONG life of dependable service

K&M

"Century" ASBESTOS CORRUGATED

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos ®

This large pilot plant of the Pittsburgh Consolidation Coal Company is the latest unit in one of the most modern research laboratories of its kind. The new building is designed and equipped for the study and development of more efficient coal gasification processes.

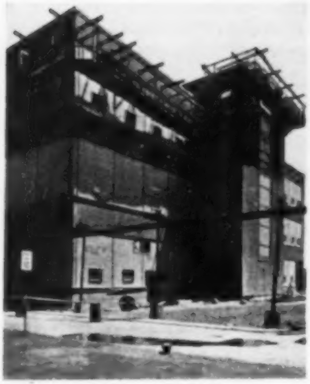
It is fitting that the fine equipment of this pilot plant should be housed in a modern building sided with good-looking, long-lasting K&M "Century" Asbestos Corrugated. This time-proved material is noted for great structural strength and ability to withstand severe commercial usage. It resists fire, weather, rot, rust and galvanic action. And no protective painting or upkeep is needed.

"Century" Asbestos Corrugated is easy to cut with a portable electric or band saw . . . easy to drill . . . easy and *fast* to apply, for it comes in 24 different sheet lengths. Can be re-used even after many years of service.

Write for name of nearest distributor and further particulars. Your inquiry will receive prompt attention.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA



GENERAL ANILINE PLANT TO OPEN SOON

After two years of building, construction nears completion on General Aniline and Film Corp.'s new $2,500,000 intermediates building at their Rensselaer, N. Y., dyestuff plant. Built by the F. H. McGraw Co., the plant (left) includes acid resisting floor bricks, and extra heavy construction to support the great weight of the massive mixing kettles (right) shown being hoisted into position.

NEWS, *cont. . .*

zations in bringing problems of industrial health to the laboratory, and among these were 11 who contributed to the cost of erecting the laboratory addition. They were:

Monsanto Chemical Co., St. Louis, Mo.; Commercial Solvents Corp., Terre Haute, Ind.; Texaco Co., New York; American Petroleum Institute, New York; Wyandotte Chemicals Corp., Wyandotte, Mich.; Standard Oil of Indiana, Chicago; Standard Oil of New Jersey, New York; Aluminum

(Continued)

When You Need MORE CORROSION RESISTANCE

in Handling Sulphuric and Many Other Acids—

Use the *NEW* *Carpenter* STAINLESS NO. 20

For an Extra Margin of Safety!

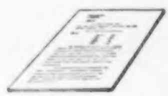
For the first time, this Stainless is available in the forms of bars, wire, strip and tubing.

If you are familiar with this alloy in its cast form, known as Durimet 20, you have a good idea of the corrosion resistance provided by Carpenter Stainless No. 20. Now that Carpenter's research has solved the problem of producing this Stainless in wrought forms, the material can take on new and important jobs.

In addition to its excellent resistance to sulphuric acid, Carpenter Stainless No. 20 is well suited for the handling of other acids and corrosive agents. For example, it is used in the handling of acetic, nitric and crude phosphoric acids, black liquor, calcium phosphate, etc.

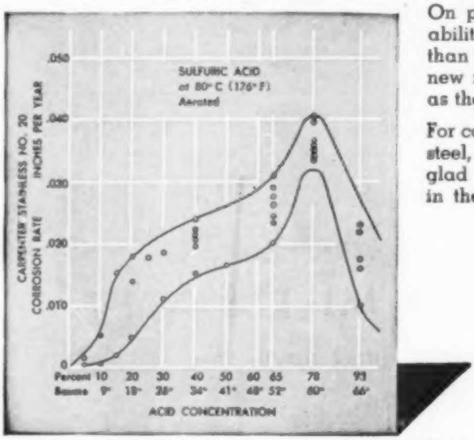
On production jobs experience has shown that the machinability characteristics of Carpenter Stainless No. 20 are better than those of Stainless Types 316 and 317. Thus, the use of this new material can contribute to fabricating economy as well as the service life of equipment.

For complete information on the properties of this new Stainless steel, drop us a note on your company letterhead. We will be glad to put a set of Carpenter Stainless No. 20 Data Sheets in the mail for you.



PHYSICAL CONSTANTS:

Density—lbs. per cu. in.	—0.289
Weight, lbs. per cu. in.	—0.287
Specific Heat	—0.12
Melting point, deg. Fahr.	—about 2650
Thermal Conductivity cgs units	—0.05



This chart shows the ability of Carpenter Stainless No. 20 to resist the corrosive effects of sulphuric acid at temperatures of 80°C (176°F). The danger zone, indicated by the "hump", is in the range of 65-93% sulphuric acid at 80°C (176°F). In this range the conventional 18-8 Cr-Ni-Mo austenitic steels (Types 316 and 317) show corrosion rates many times greater than illustrated here. While Carpenter Stainless No. 20 shows accelerated corrosion, it is far superior to the 18-8 grades and is satisfactory for most of this concentration range.

THE CARPENTER STEEL COMPANY

127 West Bern Street, Reading, Pa.

Export Department: 233 Broadway, New York 7, N.Y. "CARSTEELCO"

Carpenter

STAINLESS NO. 20

Licensed under patents of The Duriron Co., Inc.

PYRENE FIGHTS OIL FIRES WITH AIR FOAM

Pyrene Mfg. Co. put out a lot of hot oil fires in Newark, N. J. last month. No serious damage was reported, however, since all the fires occurred in the Pyrene proving grounds, where the company was demonstrating the effectiveness of its low expansion air foam extinguishing units against flammable liquids. Above, flaming tanks of no. 3 fuel oil are snuffed out in 31 sec. by stationary foam unit.

NEWS, *cont. . .*

Corp. of America, Pittsburgh; Universal Oil Products Co., Chicago; B. F. Goodrich Co., Akron; and the Hilton-Davis Chemical Co., Cincinnati, together with Du Pont and Ethyl.

The laboratory is directed by Robert A. Kehoe, who is professor of industrial medicine and head of the Department of Preventive Medicine and Industrial Health in the College of Medicine of the University, and director of the Institute of Industrial Health and a fellow of the University's Graduate School of Arts and Sciences.

(Continued)

WHERE'S the COOLING TOWER in this photo?

Upper photograph shows the "built-in," induced draft cooling tower. The lower insert is a close-up view of the propeller fans and fan guards hidden from ground level view by the coping on building.

A Beautiful Air Conditioned Building

But Where's the Cooling Tower?

That's right, where's the cooling tower? So effective has been the outer construction of this C. H. Wheeler water cooling tower, that it is in complete harmony with the appearance of the building in which it is housed and is hardly noticeable. Actually, the tower is located in the foreground of the photograph and the air inlet louvres can be seen where they give a venetian blind appearance in space ordinarily allowed for windows. As engineers and builders of cooling towers, it is conceded that most are not a thing of beauty, but where appearance is important, the casing can be made to blend with other buildings like this one—whether it be brick, stone or masonry.

In air conditioning systems for large buildings, C. H. Wheeler towers effectively cool for recirculation whatever volume of water is needed to dissipate the heat absorbed by the refrigerant. Furthermore, only a small amount of make-up water is required to compensate for drift and evaporation losses. Wide acceptance of C. H. Wheeler towers for this service is based on guaranteed water cooling performance, and the fact that C. H. Wheeler engineers especially design and custom build every tower to meet the varying cooled water requirements of any air conditioning system. For a cooling tower of lasting satisfaction and guaranteed performance, consult C. H. Wheeler. Write for Catalog No. 145.

C. H. WHEELER MANUFACTURING CO.
1808 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

SINCE 1903

C. H. Wheeler

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

NEWS, *cont. . .*

The work of the laboratory has been concerned primarily with problems of industrial health, relating particularly to the toxic hazards of industrial chemicals as these occur in the manufacture, distribution and use of these chemicals.

There is an interesting story in connection with the Kettering Laboratory. If ethyl gasoline had never come into being, there would be no laboratory. If it hadn't been for the research work of Dr. Kehoe, ethyl gasoline might never have reappeared on the market after its disappearance for about a year.

When this anti-knock industrial combustion fuel was developed, serious industrial hazards were presented in the manufacturing and distribution processes. The problem was referred to Dr. Kehoe, who solved it, and ethyl gasoline thus was made available to the motoring public at no risk to those identified with its production and distribution, or to users of the product.

Selas Acquires Davison Equipment Section

The Selas Corp. of America has formally acquired the business previously conducted by the equipment section of the Davison Chemical Corp.'s engineering division. The move enables Selas to design, produce, sell and service silica gel dehydrators, drawing on Davison's knowledge of the field. R. S. Van Note, formerly manager of Davison's equipment section has joined Selas as manager, dehydrator division.

ASME Will Meet to Discuss Coal Hydrogenation

The Petroleum-Mechanical Engineering Conference of the American Society of Mechanical Engineers will be held in Oklahoma City, Okla., October 2-5. The 20 sessions will include papers in the field of oilfield operations, pipeline operations, refining, construction materials, production of refinery equipment, and transportation. Three of the sessions will deal with the subject of coal hydrogenation. In all there will be 36 papers presented.

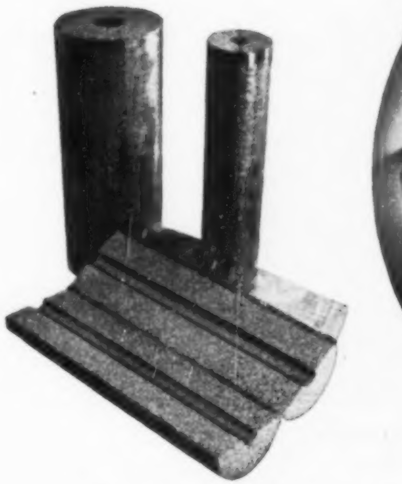
P & G Plans New Research Center in Ohio

Procter & Gamble Co. has purchased 200 acres of land near suburban Venice, Ohio, on which it plans to erect a two-story research laboratory which will be completely equipped for basic research with materials used in

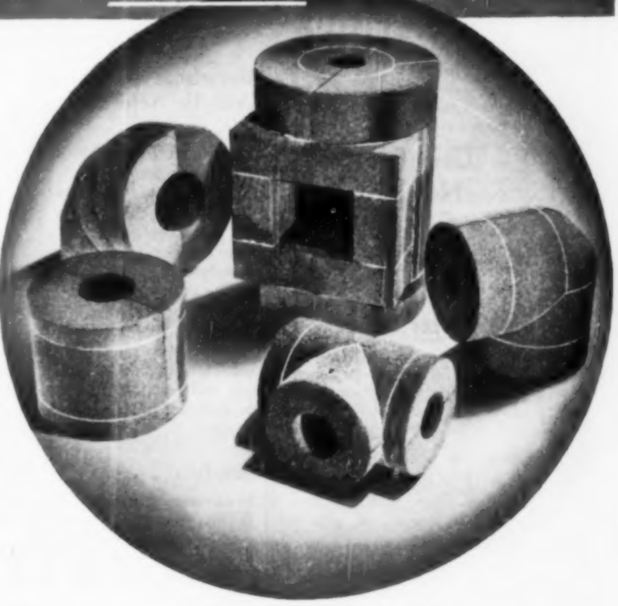
(Continued)

for piping and fittings -

PC FOAMGLAS . . . THE PERMANENT INSULATION



PC Foamglas Pipe Insulation is available in two types—Regular or unwrapped, and Factory-wrapped. The Factory-wrapped material, as shown here, is provided primarily for high temperature applications. Both types are easy to apply.



PC Foamglas Fitting Insulation is furnished unwrapped only, ready for application, or it may be fabricated in the field from standard Foamglas blocks or pipe insulation.

● PC Foamglas is the only pipe and fitting insulation that can be used for both hot and cold piping, indoors and outdoors. It is moistureproof, vaporproof, acidproof and fireproof. With PC Foamglas, you need no expensive vapor and weather protection, need not fear costly maintenance, repairs or replacement.

Foamglas Pipe and Fitting Insulation is fabricated to close tolerances to insure a close fit and to provide full thickness of insulation. The material is strong, rigid, light in weight. It is easy to cut and fit with ordinary tools, right on the job.

It takes an extraordinary insulating material to help maintain the exact temperatures required in process industries. PC Foamglas is giving long years of satisfactory service on all sorts of processing equipment, because, when properly installed, Foamglas retains its original insulating efficiency *permanently*.

Specifications and details regarding a wide variety of Foamglas installations on pipe lines and equipment have been published. Many of them are included in our new 24 page book on PC Foamglas Insulation for industrial use. Send in the convenient coupon and you will receive a *free* copy at once.

This is FOAMGLAS®

The entire strong, rigid block is composed of millions of sealed glass bubbles. They form a continuous structure, so no air, moisture, vapor or fumes can get into or through the Foamglas block. In those closed glass cells, which contain inert air, lies the secret of the material's permanent insulating efficiency.

For additional information see our inserts in Sweet's Catalogs

Pittsburgh Corning Corporation
Dept. R-89, 307 Fourth Avenue
Pittsburgh 22, Pa.

Without obligation on my part, please send me your FREE booklet on PC Foamglas Insulation, the *permanent* industrial insulation.

Name..

Address..

City........................State..........

PITTSBURGH PC CORNING

FOAMGLAS INSULATION

. . . when you insulate with FOAMGLAS . . . you insulate for good!

NEWS, *cont. . .*

the manufacture of soap, synthetic detergents and vegetable shortening.

No estimate of the cost of the project is presently available, and construction of the building is not expected to be started for some time, according to John G. Pleasants, vice president in charge of manufacturing.

Merichem Opens New Texas Cresylic Acid Unit

The Merichem Co. completed last month a new \$500,000 plant at Houston for the manufacture of three types of cresylic acid from petroleum raw materials. Construction began early last year a few months before the company's older plant was substantially destroyed in a fire.

The products that Merichem manufactures are distinguished by three boiling ranges in deg. C.: 183-205, 205-230 and 230-245. Uses of the materials include manufacture of plastics and plasticizers, disinfectants, oil production and refining, and ore flotation.

Briefs . . .

Tennessee Eastman Corp., Kingsport, Tenn., is considering various plant locations in Arkansas and Texas for conversion of raw materials for use in chemical operations at Kingsport.

Electro Metallurgical Co.'s new power plant at Ashtabula, Ohio, is progressing rapidly. A screening and storage building and a limestone kiln building which will house three kilns are being constructed. The kilns will be of the vertical type and will supply lime requirements for the company's calcium carbide furnaces. A structure will also be built to house conveyor machinery.

Hooker-Detrex, Inc., jointly owned by Hooker Electro-Chemical Co., Niagara Falls, and Detrex Corp., Detroit, will construct a trichlorethylene plant in Ashtabula, Ohio. The plant will contain three and a half story nickel-plated vats and will cost about \$2,000,000.

Rubber Latex Products Co., has begun production in its new building in Cuyahoga Falls, Ohio. The building also houses Chemco, Inc., and Harrison & Morton Laboratories. All three companies are interlocked and Harrison & Morton will do research for them all.

Tin Research Institute, Inc., Columbus, Ohio, has been formed to provide free technical service to consumers of tin in the United States. It is associated with Tin Research Institute, London, England, and Batelle Memorial Institute. Robert J. Nekervis has been appointed supervisor of metallurgical development and Robert M. MacIntosh has been made supervisor of chemical development.

Barrett's new \$100,000 pitch bay is being constructed at Ironton, Ohio. The unit, which will consist of four bays, will be used for a new pitch product, carbon pitch, used in the manufacture of carbon brushes and electrodes for electric furnaces.

—End

READERS' VIEWS AND COMMENTS

Unrecognized Hazard

To the Editor:

Sir:—A recent violent explosion at the Du Pont Chambers Works, Deepwater, N. J., points up the danger of overheating a mixture of p-nitrotoluene and sulphuric acid. The fact that this hazard has not been generally recognized suggests that this explosion should be given wide publicity in the scientific and technical literature. Fortunately, only minor personal injuries were suffered by workmen in the building.

The explosion took place in a 500-gal. jacketed kettle in which 1,000 lb. of PNT (p-nitrotoluene) was being dissolved in 3,995 lb. of 93 percent sulphuric acid, when the temperature of the charge got out of control.

A careful study of all the conditions surrounding this occurrence has led to the belief that this explosion was identical with, or resulted from, the exothermic reaction which takes place with explosive violence when a PNT-sulphuric acid solution is heated to 160 deg. C. Normal operating temperature for the PNT-sulphuric acid dissolving kettle is 80 deg. C., maintained by steam heat.

Overheating of the charge was apparently caused by failure of the diaphragm valve on the automatic steam temperature controller, and subsequent attempts at manual control failed to check the temperature rise resulting from the strongly exothermic reaction which set in shortly after failure of the automatic temperature controller. The last temperature noted was 135 deg. C., shortly beyond which the explosion occurred.

To minimize the danger associated

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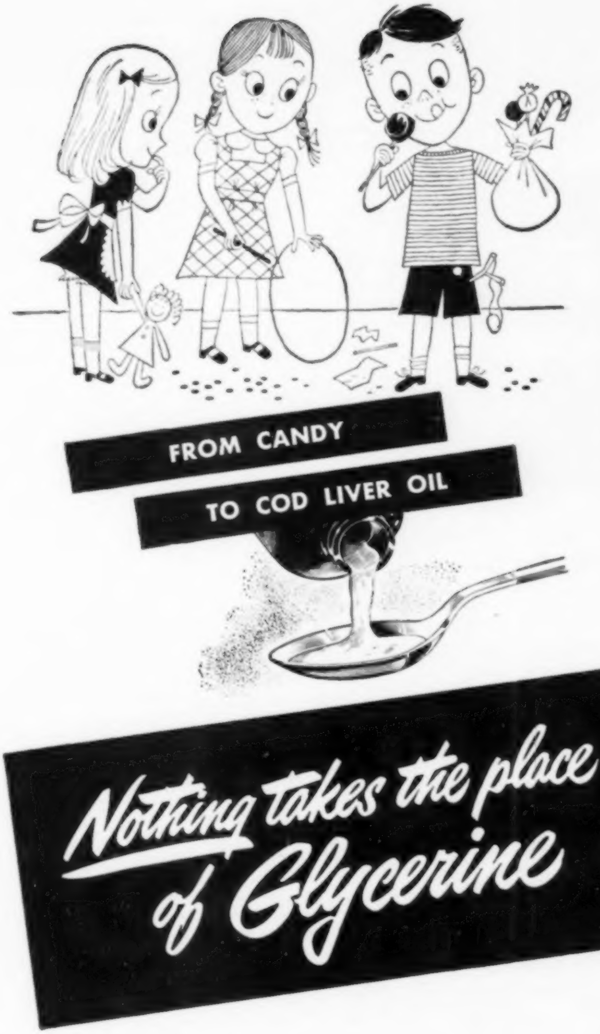


Glycerine in candy? *Of course!*

U.S.P. glycerine is a food. It's almost as sweet as sugar. It's wholesome . . . nutritious . . . digests normally in much the same way as sugars and fats.

And—glycerine is a solvent and extractant for base flavors. It's a softener . . . a humectant. It adds smoothness to mixtures . . . distributes flavors uniformly.

You can find glycerine, too, in flavoring extracts . . . frozen foods . . . meat stamping inks . . . margerine emulsifiers . . . bread preservatives . . . cod liver oil emulsions—in almost every type of food product. Its combination of physical and chemical properties can be matched by no other substance.

That's why in the food industry—and in almost *every* industry—*Nothing takes the place of glycerine!*

GLYCERINE PRODUCERS' ASSOCIATION
295 Madison Avenue
NEW YORK 17, N. Y.

Technical GLYCERINE NEWS

GLYCERINE SECTIONS OF BEILSTEIN TRANSLATED! Now available for the first time, an English translation of the Glycerine Sections of Beilstein's famous *Handbuch der Organischen Chemie* (4th Edition). Complete in *one* volume entitled "GLYCERINE AND SOME GLYCERINE DERIVATIVES." Publication authorized by the Attorney General of the United States. Compiled and edited by Dr. R. N. Du Puis, Dr. C. S. Miner, Jr. and J. B. Segur—long acknowledged as authorities in the field of Glycerine and its properties. Amassed in its 210 pages are an unusually large number of Glycerine derivatives with extensive cross-references. Also included are a complete table of contents and a detailed index of the derivatives and fatty acid esters of Glycerine. A timely, comprehensive volume for your chemical reference library. Order from the Glycerine Producers' Association enclosing $2.50 (check or money order) for each copy.

* * *

ARTICLES ON GLYCERINE NOW AVAILABLE WITHOUT CHARGE. Reprints of recent magazine articles on the use of glycerine in various phases of the food industry may be obtained by checking the appropriate item on the coupon below. The titles of these articles are: *Glycerine in Vanilla Flavors* (F-12), *The Use of Glycerinated Eggs* (F-13), and *Glycerine in Candy Coloring Compounds.* (F-14)

* * *

FOR DIRECT CONTACT FREEZING, glycerine, glycerine-salt, and glycerine-invert sugar solutions have been found by one experimenter to be more satisfactory than any of the other salt, syrup, or combination solutions tested for direct contact freezing. (F-15)

* * *

A VEHICLE FOR VANILLA contains corn syrup, glycerine U.S.P., and water. The solvent is said to be inexpensive, fluid, stable, and free from fermentation. (F-16)

GLYCERINE PRODUCERS' ASSOCIATION, DEPT. 4
295 MADISON AVENUE
NEW YORK 17, N. Y.

I should like to know the source of those items appearing in Technical Glycerine News which I have checked below.

☐ F-12 ☐ F-13 ☐ F-14 ☐ F-15 ☐ F-16

NAME..........

COMPANY..........

ADDRESS..........

with this potentially hazardous reaction, Du Pont has adopted the three following precautionary measures:

1. Installation of a 65 deg. C. hot-water circulating system on the heating coils in the PNT-sulphuric acid dissolving kettle, in place of steam heat.
2. Heating the sulphuric acid to 60-65 deg. C. before adding the PNT, to effect rapid solution and to avoid lumping of the PNT while it is dissolving.
3. Providing a very rapid means of drawing off and drowning the PNT-sulphuric acid solution, should any unusual rise in temperature occur.

JAMES K. HUNT

Public Relations Department
E. I. du Pont de Nemours & Co.
Wilmington 98, Del.

Adapt Color Chart For Plastics Tests

To the Editor:

Sir:—The article "New Corrosion Test for Plastics" which was published in the July issue of *Chemical Engineering* contains on p. 98 a table for rating changes in the solutions to which the samples were exposed.

In the first part of the table the possible changes of color of the solutions are enumerated and rated according to the intensity of coloration. Since no color standards are set up, this may allow too much liberty to the individual observer and consequently lead to different evaluations.

The June 1949 issue of the *Hercules Chemist* contains a color chart for the evaluation of rosins and resins based on the U. S. Standards for rosins. The chart appears to be eminently suited for checking the color of the solutions in our test and allows a much closer rating. To tie our table to the Hercules chart, the middle column of the table below should be written into the first part of our table.

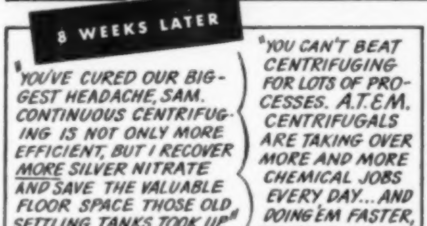
Solution	U. S. Standards or Chart	Rating, Percent
Clear, water white	......	100
Clear, trace yellow	Z	98
Clear, slight yellow	Y	95
Clear, moderate yellow	X	90
Clear, strong yellow	WW-WG	80
Clear, slight red or brown	N, M, K, I	70
Clear, moderate red or brown	H, G, F	60
Clear, strong red or brown	E-D	40
So strongly colored as to be opaque	B	10
Actually black and charred looking	......	0

Copies of the color chart can be obtained by writing Hercules Powder Co., Wilmington, Del.

H. H. LEBACH

Haveg Corp.
Newark, Del.

—End



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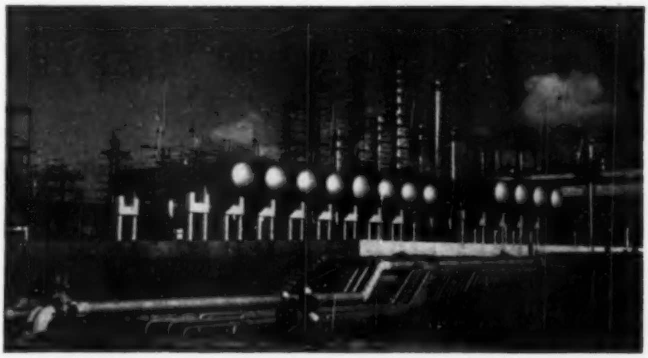
News From Abroad

SPECIAL CORRESPONDENCE



British petrochemical output jumped last month as Shell's Stanlow unit went on stream. It may cut Britains dollar needs by almost $5 million.

Shell Opens New Stanlow Petrochemical Plant

London—Shell's new Stanlow petrochemical works was opened last month. Annual capacity is estimated at 24,000 tons of organic solvents. The firm claims that the Stanlow chemical unit is the most up-to-date of its kind in the world. Almost every type of solvent can be made at the versatile plant. Its products will cut deeply into the import requirements of the United Kingdom. Estimates of this cut run as high as $5 million per year. Output of this unit will also dig into U. S. imports to ECA countries worried by dollar shortages.

The new units operate on two basic petroleum products — propylene and butylene. Propylene is converted into isopropyl alcohol and ether. They are separated in the distillation unit. Part of the output of these products is sent to storage. Some of the isopropyl alcohol is sent to converters as raw material for the plant's acetone production. Some acetone is further processed to diacetone alcohol which in turn is sold as a final product or converted to mesityl oxide. Some of the oxide is used as raw material for methyl isobutyl ketone.

The new plant will make a number of additional products from butylene. First the butylene is treated with sulphuric acid to get secondary butyl sulphate. This is converted to secondary butyl alcohol which in turn may be used as the raw material for methyl ethyl ketone.

Synthetic Fuels for India Nearing Reality

Calcutta—Closing of a deal for the construction of a synthetic petroleum plant for Indian government ownership and operation is reported near. The plant, which is expected to cost some $200,000,000. will be sited in the Asanol industrial area northwest of here. Koppers Co., which has been engaged in a project survey, is expected to get the construction contract while a supervisory contract is reported to be going to a German petrochemical firm.

Hungary's Reds Take Over Engineering Societies

Budapest—All Hungarian engineers have been ordered, under a government decree, to register with the Hungarian Scientific Council. Purpose of the compulsory registration, according to government spokesmen, is to determine exactly what engineers, architects, and technicians are available for reassignment under the country's Five Year Plan. A shortage of professional men reportedly prompted the action.

This latest move closely follows on the heels of a government decision to break up the Engineer and Architects' Trade Union, an organization in which most Hungarian engineers of all professions held membership. Instead, the engineers have been instructed to affiliate with individual labor unions according to their specialty. A design engineer, for example, working in a plant has to join the same trade union as the workers of the factory.

In each trade union, where engineers become affiliates, a special secretary is assigned to represent the interests of the professional personnel. In nationalized communist-controlled Hungarian industry, it is the unions which place and fill staff vacancies.

Under the new order, requiring registration, all engineering societies have been brought under the control of the Scientific Council. Important societies affected are: mining and metallurgical society, mechanical industrial society, transport and structural scientific society, textile industrial society, kinotechnical society, radio and communication technical society, civil engineering construction society, chemical society, physical society, and optical society.

United States Firms Expand Oil Rights in Canada

Ottawa—There is widespread interest in the spectacular oil developments in Alberta where 640 acres of Crown land in the Redwater field have been purchased by the Amereda Petroleum Corp. of United States for $3,223,000, with this payment giving the latter company the right to mineral rights, though payment must be made to the Alberta Government of a royalty of 12½ percent on the value of the oil produced.

Experts state that oil production in Alberta has reached the point where it may have to be curtailed until more can be handled by the refineries or that can reach a market. Meanwhile,

(Continued)

the Imperial Oil is making adjustments to its refinery at Edmonton and the Transport Board has approved the construction of the Edmonton-Regina pipeline and work is expected to start on this project in a few months.

In addition, interest has been enlivened in western oils by the purchase of 17,000,000 acres of Crown land in Saskatchewan by 12 United States companies.

Indian Firm Will Make Paint For Australia

Melbourne — Products of Spartan Paints Pty. Ltd., Melbourne, will be made under license in Madras, India. Spartan Paints is a subsidiary of Hardie Trading Co. Ltd., manufacturers and importers of plastics and other chemicals.

Addison & Co., the Indian licensee, will produce 50,000 to 60,000 gal. of paint a month, using both resinous and mineral pigments under a formulary supplied by Spartan Paints. Plant for an initial production of 10,000 gal. a month has already been procured from the U. S. and Britain. The principal lines to be produced at present include paints for car finishing, and aircraft and industrial coatings.

A. E. Sangwell, managing director of Spartan Paints, told *World News* on his return from India that Spartan controls no exclusive patents but obtained an interest in the Indian project for its engineering assistance and the use of its formulary.

Plant Expansion Keynotes Australian Chemical News

Melbourne—Euston Lead Co. (Australia) Ltd. is ready to start production of white lead at Braybrook, Victoria, under license from the Glidden Co. Ed Turnbull, chief engineer of the American company, is supervising the initial production.

Beetle Elliott Ltd., Rozelle, New South Wales, has started production of ebonite-filled phenolic molding powders. Because of its resistance to heat and steam, products made from the powder fill a gap in the range of Australian plastics. Tensile strength after 48 hr. in autoclave at 20 psi. steam pressure is lowered by only 1,200 psi. from the normal 6,500 psi. The same firm has also acquired the manufacturing rights to Ciba's melamine molding powders. Small quantities are already available from Australian production.

Kenworth Ltd. has purchased a factory building at Springvale, Victoria, where plant has already been installed for production of anti-corrosion linings and coatings under an exclusive American license. A production executive of the American firm is in Australia training and instructing Kenworth staff in the know-how of manufacture.

Sulphates, Ltd. is making a capital issue of £50,000 to obtain funds for expansion of operations. Main products are various grades of alumium sulphate, and the potash and ammonium alums. Australian bauxite and alunite are the mineral base of this industry. The chemical plants are located at Yarraville and Spotswood, in Victoria.

Though Australian sulphuric acid production is still running close to the prewar average of 500,000 tons a year, ammonium sulphate output this year may double the 1938-39 record of 24,300 tons. Superphosphate output is looking up after years of stagnancy and promises to set a new record this year. Among heavy industrial acids, HNO, has made the most conspicuous advance since the war, though present production is still small. It is likely to exceed 5,000 tons this year, which is a nearly tenfold increase over 1938-39.

Salt Cake Market Creates Confusion in Canada

Ottawa—Statements that the sodium sulphate plant in Chaplin, Saskatchewan, has "closed down" have been denied and termed misleading by Acting Premier C. M. Fines of that province of Canada, with the latter stressing that the impression that the plant is now closed is not correct. It is operating on a basis of a period of full 24-hr. production until storage bins are full, then closed for a period and restarted when storage has reached a low point.

State of the market does not warrant continuous operation at present, it is pointed out, but in the opinion of responsible officials, this is a temporary condition, Mr. Fines stated, adding that there is no "shutdown."

Britain's Hot Laboratory at Harwell Ready to Start

London—One wing of the new Radiochemical Laboratory at the Atomic Energy Research Establishment, Harwell, is now ready. Ministry of Supply says that the building is the most complicated project of its kind undertaken this side of the Atlantic.

The laboratory will be used primarily for research on the chemical problems of separating the element plutonium from uranium rods that

have been irradiated in a pile. The rods also contain very radioactive fission products, and the chemical separation problem involved means that the scientists will be tackling one of the most difficult jobs in the Atomic Energy program.

The laboratory will also be used for other chemical work with radioactive materials, including the separation of radio-isotopes produced in BEPO (British Experimental Pile), and processing materials that have been irradiated in the pile.

The type of work to be carried on in the laboratory means that entirely new problems—particularly regarding the health and safety of the worker and the control of any active material in dust, gases or effluent—will have to be tackled.

The building—designed to provide every facility for working with radioactive materials—is known as the "hot" laboratory.

In the center of the ground floor is the administrative block. This consists of offices, laboratories, stores and workshops. Connected to it by air locks are two wings. These house the "hot" laboratories. In the first floor, which is windowless, and the tower is a complex system that carries the main services and air ducts to the special ventilating plant. The operation of these is supervised in a central control room. There is reserve equipment for any failure.

SAFETY IS THE KEY-NOTE

A hospital finish is used throughout the building and corners are rounded. Changing rooms and showers are provided for staff entering or leaving "hot" areas, and foot-operated wash basins, with air-dryers, are situated outside each laboratory group. Doors in "hot" area corridors are automatically operated by photoelectric cells to reduce still further the risk of contamination from the hands. Equipment for monitoring hands, clothing and body—that is to say, checking for radioactivity—is provided at washing places and an automatic monitoring system checks people leaving the building.

Active dust and fumes from the chemical processes are a possible airborne danger to health; the extraction system deals with this problem, while strict cleanliness minimizes the dust. Dust-free air is admitted, and its flow, at maximum rate of some 360,000 cfm. is distributed so as to extract any active dust and fumes. This maximum rate of flow is equivalent to 120 complete air changes per minute in a laboratory; though, under normal conditions, the rate will not exceed 40 changes per minute. Any active solids removed in this way are retained by precipitators

(Continued)

so that the exhaust air leaving the central square tower is harmless. Similarly, all effluent through the drainage systems is segregated and monitored before final disposal.

Work with active materials will usually be carried out in ventilated fume cupboards where remote control of processes from behind walls of interlocking lead bricks may be used. Separate concrete-surrounded rooms are provided for work with highly radioactive materials.

All laboratories are continuously monitored so that the staff may know the amount of radiation to which they are exposed. Fire alarm and alarms for radioactivity risks are provided throughout, and the location of an alarm signal is recorded centrally.

The building was designed by the Ministry of Works and constructed by contractors engaged by them.

Dutch Try Paper Sacks To Cut Rubber Costs

Amsterdam—Dutch rubber growers in Indonesia have made an experimental shipment of rubber sheets in paper bags instead of in matting or cases. This, it is stated, will bring about a substantial reduction in the weight of shipments, and a reduction in shipping costs.

Alcohol Unit at Gatineau Corrects Operating Problem

Ottawa—New huge plant in the Gatineau region near Ottawa of Commercial Alcohols Ltd., has been able to get only about half capacity production. This is due to difficulties in the supplies of waste sulphite liquor from the adjoining paper plant. It is said plant was not able to get sufficient supplies of waste liquor due to leaks in the pits which hold the liquid. Pits are being relined. However, only one can be done at a time without interfering seriously with paper production. This means that it may be late August or September before the situation will be remedied. The new plant commenced production early in January.

India Hikes Tariff on Some Chemicals by 300 Percent

Bombay—Import duties on sodium sulphite, sodium bisulphite and sodium thiosulphate have been nearly trebled by the Indian government. But the margin of Imperial Preference has been reduced. The new rates, based on hundredweights, are: British sodium sulphite \$6.90, non-British,

(Continued)

$7.80; British sodium bisulphite $5.70, non-British $6.45; British sodium thiosulphate $3.90, non-British $4.65.

Meanwhile, duties on calcium chloride imports have been extended at current levels for another year. Non-British calcium chloride will be taxed at $1.45 per cwt. and British at 98c.

Britain Has Big Hopes for Better Chemical Exports Due to Argentine Trade Deal

London—Supplies of all important chemicals, except sulphuric acid and caustic soda, are sufficient to meet essential needs in Britain. Production continues to expand slowly in line with increasing requirements, but there are weak spots. This is shown by price cuts in some sectors. These reductions of market prices are largely due to parallel movements in the world market, but the prices of some home-produced chemicals have been lowered irrespective of changes in foreign markets. This is a reflection of growing competition and lower raw material costs; producing costs in the chemical industry, such as wages, fuel, transport and plant depreciation, have not yet declined and do not seem likely to decline in the future.

The British home market is capable only of a very limited expansion. Therefore, leading chemical manufacturers are paying increasing attention to export sales. Orders from foreign buyers have increased of late, after a somewhat sluggish spring season, and the volume of shipments has also increased, though not yet to the extent desired by the authorities. In May exports of chemicals, drugs, dyes and paints amounted to $32,000,000, against $27,600,000 in April. Chemical exports in the first half of 1949 were more than $20,000,000 higher than the corresponding figure of 1948. Nevertheless, British chemical exporters still have to cover a long way before they can reach the export target of $36,000,000 a month set by the Board of Trade for the end of this year.

British exporters made a special effort to beat the deadline for new import restrictions in the Union of South Africa, one of the biggest buyers of British chemicals, but although a decline in less essential exports to South Africa is anticipated for the next few

(*Continued*)

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Hundreds of companies, scores of industries throughout the United States are saving time, saving money, improving their products, or increasing safety by using Amsco solvents.

The list of uses below, while far from complete, will give you an idea of the almost limitless ways in which these versatile solvents may be used. Whether or not your particular type of business is mentioned here, investigate what Amsco can do for you.

CHEMICALS—As ingredients in many chemical reactions and also as a raw material in the manufacture of some synthetic chemicals.

CLEANING—Used in preparation of detergents for commercial dry cleaning of fabrics and as spot removers; also as a cleaning solvent for textiles, metals and machine parts.

EXTRACTION—Most of the close boiling solvents are used as the extraction medium for fats, vegetable oils, glue, rosin, resins and other natural occurring products. Also as extraction solvent for production of certain pharmaceuticals.

GLUES, ADHESIVES—Used as a solvent for adhesive compounds and in production of industrial and decorative adhesive tapes.

INK—These have application as solvent in production of intaglio, heat set inks, printing inks, etc.

INSECTICIDES—Several are used as solvent and carrier for insecticides.

OILCLOTH, ARTIFICIAL LEATHER AND COATED PRODUCTS—Applied as a solvent in the printing of table and floor oilcloth; also in the impregnation of various types of fabrics.

PAINT, VARNISH & LACQUERS—Used as solvent and thinner in manufacture of decorative and industrial paints, varnishes, lacquers and enamels. Also varnish removers and specialties.

PRINTING—Used as a general solvent and cleanser in printing plants for the cleaning of presses, plates and rollers.

RESIN—Amsco naphthas are used in the production of resin solutions including gloss oil.

RUBBER—Because of their qualities certain Amsco naphthas have application as a solvent in the preparation of rubber cements, rubber shoes, rubber dip goods. Also vital in the manufacture of rubber tires, both natural and synthetic.

TEXTILE—Amsco naphthas are used for cleansing fabrics and also for pad dyeing, printing and treating.

WAX & POLISH—Amsco naphthas are ingredients in many compositions of liquid and paste waxes and polishes, such as for floors, furniture, shoes, etc.

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years, it is not expected that British chemical exports to this market will suffer greatly by the currency difficulties experienced by the Union. Other commonwealth markets, like India and Australia, continue to hold their prominent position in Britain's chemical export trade, and it is hoped that the satisfactory solution of the Intra-European Payments problem will assist in the expansion of British chemical exports to the continent.

Great satisfaction is being expressed in British chemical quarters at the opportunities opened by the five-year Anglo-Argentine trade and payments agreement. Under this treaty the British Government has undertaken to facilitate exports of chemicals, dyes and colors to the Argentine worth \$23,000,000 in the first 12 months of the agreement, compared with shipments of chemicals, dyes, colors and pharmaceuticals from Britain to the Argentine of \$14,600,000 in 1948, \$10,000,000 in 1947 and \$2,800,000 in 1938. The expansion of British chemical exports to the Argentine is thus expected to continue at an accelerated pace.

Last year the most important chemical export item in the trade with the Argentine were disinfectants, insecticides, weed-killers and sheep and cattle dressings which accounted for \$4,400,000. Other important items were caustic soda (\$1,700,000), sodium carbonate and bicarbonate (\$830,000), and finished coal-tar dyes (\$1,040,000). These products were shipped to the Argentine although the British home market demand could not be fully met. This was done since Britain's need for the Argentine's surplus produce, in particular meat, vegetable oils and high-grade feeding stuffs was urgent. No change is anticipated, and the British authorities will therefore do all in their power to encourage the shipment to the Argentine of chemicals and other export goods in order to balance the envisaged increase in Argentine food deliveries.

The Argentine agreement is of particular interest to British chemical exporters, not only because that country has always been one of the largest foreign markets for British chemicals, but also because growing foreign competition is being noted in some other valuable export markets. The recent trade agreement between Belgium and western Germany, for instance, provides for German chemical deliveries to Belgium equivalent in volume to present British sales in this small but important market which, from the British point of view, deserves special attention as a hard-currency area. The

(Continued)

recent West German trade agreement with Italy provides for German chemical exports substantially larger than present British sales in the Apennine peninsula. Growing competition is also being experienced by British exporters of coal-tar products from various European sources.

The contract for the big oil refinery extensions at the plant of the Anglo-American Oil Co., Ltd., a subsidiary of Standard Oil of New Jersey, at Fawley near Southampton, on the English Channel coast, has been placed with the Foster Wheeler Corp., New York, and construction work on the 970-acre site is scheduled to begin shortly. The throughput capacity of the Fawley plant will be raised from 800,000–900,000 long tons now to over 5,000,000 tons at a total cost of \$150,000,000. In prewar days the cost would have been \$80–90,000,000. It is estimated that it will take about three years to complete the extensions which will make the Fawley refinery the biggest in Europe and enable it, through installation of new modern catalytic cracking units, to produce a greatly extended range of petroleum products. The pipestills used at the first stage will each have a capacity of 60,000 bbl. per day and the cracking plant will be able to deal with some 37,000 bbl. daily. When completed, the refinery will employ 2,500 people.

The Shell combine which has embarked on two new refinery schemes in the British Isles expects that the new refineries at Stanlow and Shell Haven will be completed by 1952 and 1953 respectively. Construction work is being pushed ahead at maximum speed, but delivery of materials has imposed some delays on the progress of construction. At Stanlow new tankage and columns for the first distilling unit are in place.

The Anglo-Iranian Oil Co. Ltd. is engaged on extension work at its refinery at Grangemouth where the throughput capacity is to be increased from 360,000 to 1,500,000 long tons.

Formosa Wants Aid for Its Ammonium Sulphate Plans

Taipeh—Chemical fertilizer shortages are seriously crippling the agricultural output of the rich island of Formosa. Estimated requirements of chemical fertilizers for the current year are 470,000 tons, but domestic production will furnish only 110,000 tons. ECA purchases probably will add only 30,000 tons.

With the current world shortage of rice, Taiwan could probably import

(*Continued*)

fertilizer to boost rice production for export. And it is possible that the provincial government will soon begin negotiations along this line. There is also a long term need for construction of additional production and financial assistance.

Back in 1937 under Japanese occupation, Taiwan exported 758,000 tons of rice. Last year, however, exports were negilgible. This will continue until adequate fertilizer supplies are available.

Taiwan's fertilizer industry is controlled by the Taiwan Fertilizer Company, Ltd. which took over the five Japanese-built plants in 1945. The company is jointly operated by the provincial government and the nationalist government's National Resources Commission.

The plants are located in Keelung, the northern ports. No. 1 has a potential output of 100,000 tons of calcium cyanide, and includes 38 coke furnaces, 2 lime kilns, 2 electric calcium carbide furnaces and 2 air liquefaction units; No. 2 was 80 percent destroyed by American bombing, but has been repaired so that its present potential production is 12,000 tons of calcium superphosphate.

No. 3 plant is located at Kaohsiung. It also was heavily damaged during the war. Now, under rehabilitation, it will eventually be able to produce 20,000 tons of calcium superphosphate. No. 4 plant at Lutung was undamaged and has an output of 30,000 tons of phosphate fertilizers. Plant No. 5, started by the Japanese at Sintso in 1941, is being completed and will have an annual production of 18,000 tons of calcium cyanide.

During 1946 and 1947, UNRRA supplied Taiwan with 150,000 tons of fertilizers. ECA has made its contributions both in fertilizer and in limited funds for plant rehabilitation. The Taiwan government originally planned to ask ECA for $30,000,000 for the construction of an ammonium sulphate plant, but this was cut down to a smaller plant costing $7,500,000. Neither was approved. This need still exists and with foreign financing may yet come about.

Pakistan's New Sugar Plant Dwarfs Previous Capacity

Karachi—Production by the end of this year is the goal of engineers now installing final equipment at the Premier Sugar Factory & Distillery Ltd.'s new plant at Marden. Located in the Northwest Frontier Province, the plant will rank as one of the two largest in non-Russian Asia.

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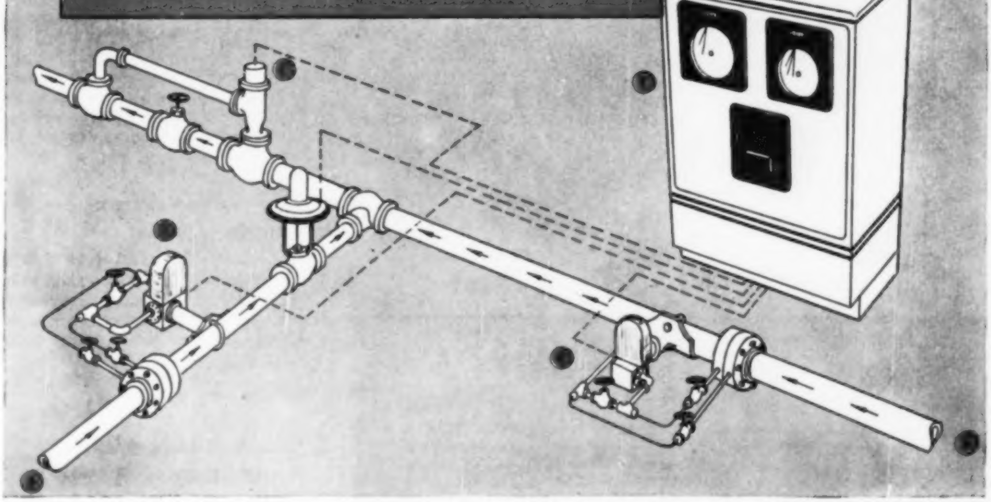
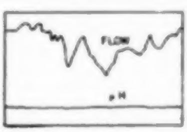
ANOTHER TOUGH pH PROBLEM SOLVED!



. . . by FOXBORO Coordinated Control

THE PROBLEM: To control the pH of fluid (A), a corrosive material varying both in volume and concentration. Flow and unadjusted pH of (A) are shown in curves (left). Since there is no capacity in the system, the high rate of change of flow makes simple pH control inadequate. Adjusting chemical (B) is in a head tank and has constant concentration.



THE SOLUTION: Flow ratio control is employed to maintain the flow of (B) in precise relation to the varying flow of (A). The ratio itself is continuously adjusted by a pH controller. Flow measurements are transmitted to the ratio controller by stainless steel differential pressure cells (D) and (E), while pH is measured at a point (C) where the reaction is complete.

INSTRUMENTATION: *Foxboro d/p Cells* (D) and (E) are mercury-less, highly accurate and corrosion-free. Max. working pressure, 1500 psi. Min. differential range, 0-100".

Flow-Ratio Receiver-Controller, with Pneumaticset — a Model 40 Stabilog*, having proportional and automatic reset control-action.

pH Dynalog* Electronic Controller provides continuous *stepless* balancing. Unmatched sensitivity, response, and accuracy. No slide wires. Range 3-10 pH. Provides Pneumaticset control with proportional reset and derivative (Hyper-Reset) action. pH flowtype electrode assembly for pressures up to 30 psi. Maximum temperature 194°F.

Cabinet (F) is of dustproof construction, rust-proof finish, with removable instrument panel. All instruments completely wired and piped before shipment.

The same facilities and engineering skill that produced the solution above are available to help find the most effective answer to your specific pH control problems. Why not discuss them with your nearby Foxboro engineer? Send for pH Bulletin 430. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U.S.A.**

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FOXBORO REG. U. S. PAT. OFF. **COORDINATED CONTROL**

The factory will have a capacity of 50,000 metric tons of sugar a year. This is larger than all of Pakistan's present plants together whose combined production is only 30,000 tons. Estimated national requirements are about 235,000 tons a year.

Planned for later is a power alcohol distillery with a proposed capacity of 12,000 gal. a day. Also being constructed is an expansion of the Nizam's State Sugar Factory in Hyderabad, India. It will retain its position as the largest on the Indo-Pakistan subcontinent with a rated capacity of 300 metric tons a day.

Pakistan to Get Own Chlorine Plant

Karachi—Amroc Ltd., New York, is supplying the first chlorine plant to be set up in the dominion of Pakistan. The plant is intended to reduce the imports of liquid chlorine from India. Its four mercury cells will deliver 5 metric tons a month for the use of the Karachi water system.

Canadian Industries Hit Record Output in 1948

Canada's chemical industries maintained their upward climb of recent years during 1948 to set a new record value for output of $554 million at factory prices, according to a preliminary report just issued by the Canadian Government. Higher output values were recorded for all industries in the chemical group. Percentage increases over 1947 were as follows: heavy chemicals, 20.6; fertilizers, 7.1; compressed gases, 14.8; paints, 15.5; soaps, 18.2; polishes, 17.5; inks, 12.8; adhesives, 26.1; preliminary plastics, 21.5; and vegetable oils, 37.0.

The value of imports of chemicals and allied products in 1948 was the highest on record at $118 millions, an increase of nearly 5 percent over 1947. About 90 percent of the imports were from the United States.

Principal statistics for the industry for the year 1948 were as follows:

Industry	No. of Plants	Value of Products (Thousands of dollars)
Coal tar distillation	11	6,344
Heavy chemicals	34	71,525
Compressed gases	45	11,026
Fertilizers	32	62,932
Medicinals and pharmaceuticals	211	70,514
Paints and varnishes	116	80,724
Soaps and washing compounds	148	62,900
Toilet preparations	99	18,604
Inks	31	7,919
Vegetable oils	13	52,620
Adhesives	26	9,354
Polishes and dressings	55	10,268
Plastics (primary only)	12	14,319
Miscellaneous	197	75,061
Total	1,030	554,724

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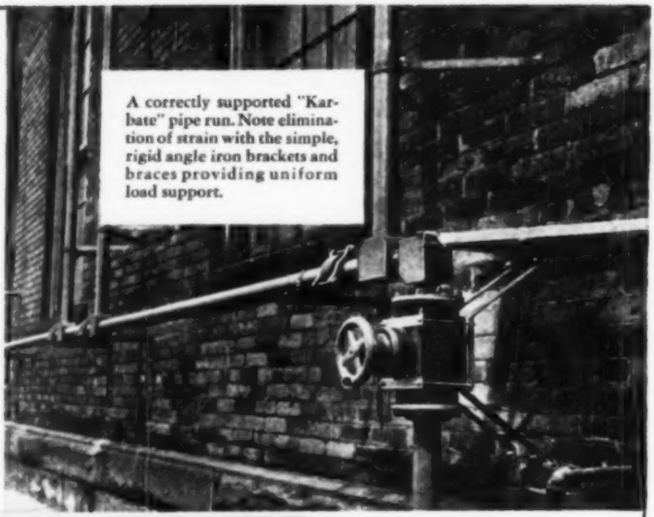
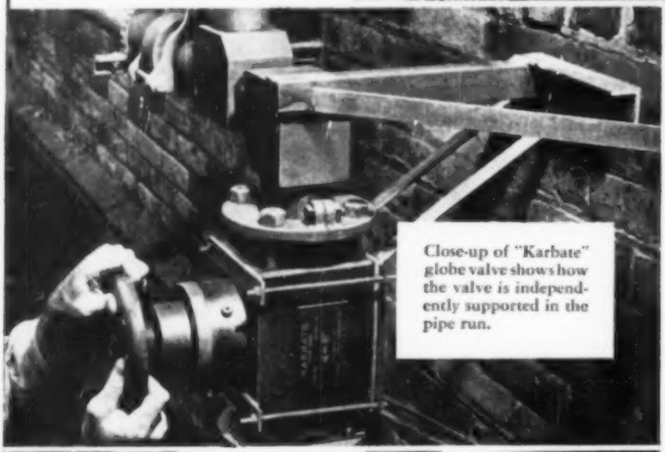
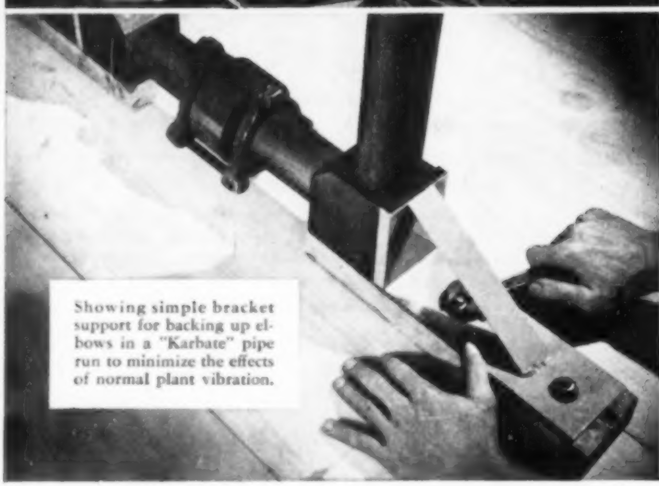
How to support a "Karbate" pipe line_



A correctly supported "Karbate" pipe run. Note elimination of strain with the simple, rigid angle iron brackets and braces providing uniform load support.



Close-up of "Karbate" globe valve shows how the valve is independently supported in the pipe run.



Showing simple bracket support for backing up elbows in a "Karbate" pipe run to minimize the effects of normal plant vibration.

KEEP "KARBATE" PIPE ALWAYS IN STOCK

- Resists the action of acids, alkalies and other chemicals
- Light weight with adequate strength
- Resistant to mechanical shock
- Immune to thermal shock
- Easy to machine and install
- Full range of sizes and fittings

Write for Installation Manual M-8801 A. Address Dept. CE.

•

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Unit of Union Carbide and Carbon Corporation

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Division Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Foreign Department—New York, U.S.A.

These products sold in Canada by Canadian National Carbon Co., Ltd., Toronto 4, Canada

The Corrosion Forum

EDMOND C. FETTER, *Assistant Editor*

Hydrofluoric Acid versus Construction Materials

Part I of a symposium in which a representative group of construction materials are evaluated for services involving HF.

Karbate immersion heaters withstand a nitric-hydrofluoric mixture.

Carbon and Graphite

J. F. REVILOCK, *National Carbon Co., Cleveland Ohio*

Carbon, graphite and Karbate (National Carbon's tradename for impervious carbon or graphite) are used extensively for handling hydrofluoric acid and solutions in which hydrofluoric acid is a contaminant. Carbon and graphite are resistant to the action of all concentrations of hydrofluoric acid, including anhydrous HF, at all temperatures employed in industrial processes involving the aqueous or anhydrous materials. Karbate is resistant to hydrofluoric acid concentrations up to 48 percent at temperatures through the boiling point, and to concentrations up to 60 percent at 185 deg. F.

In the production of hydrofluoric acid and anhydrous HF Karbate materials are used satisfactorily in the weak acid absorption equipment. The absorption towers are lined with carbon brick while other tower parts such as distributor trays and packing support grills are fabricated from carbon. Carbon Raschig rings are used as packing material. Karbate cascade coolers and centrifugal pumps are giving excellent service in the recirculating cooling systems connected to the absorption towers for the removal of the heat of absorption. Many of the storage tanks and other auxiliary equipment throughout a hydrofluoric acid plant are lined with carbon brick, one plant employing a carbon brick lined steel tower for cutting anhydrous HF.

To date several hundred Karbate immersion type heat exchangers have been installed in nitric-hydrofluoric acid, alloy-steel pickling tanks. Karbate plate type heat exchangers (see picture) have become a "must" in this application, giving an economical service life far in excess of any heater previously used. The hydrofluoric acid concentration in these alloy-steel pickling tanks varies from 2 to 5 percent, while the nitric acid varies from 15 to 20 percent. Operating temperatures range from 150 to 212 deg. F. Also in this application, the pickling tanks are lined with carbon brick, and the drain lines from the pickling tanks to the acid disposal units are fabricated from standard Karbate pipe and fittings.

The use of carbon spray towers equipped with graphite baffles and Karbate spray nozzle assemblies in scrubbing systems for the removal and recovery of fluorine from stack gases is increasing, particularly in the fertilizer and phosphorous acid industries. The fluorine is scrubbed from the gas with water or a mild alkali, forming a weak HF solution. Karbate centrifugal pumps are also used in conjunction with such systems.

Chlorimets

WALTER A. LUCE, *Duriron Co., Dayton, Ohio*

Chlorimet 2 and Chlorimet 3 show excellent resistance to hydrofluoric acid and solutions containing this acid in appreciable percentages. Even though these alloys are relatively new to the chemical industry, considerable laboratory and plant testing was undertaken to determine corrosion resistance. Laboratory tests on these alloys in dilute acid showed the following results:

	Corrosion Rate, Mils per Year		
HF Conc.	5%	15%	25%
Chlorimet 2			
Room temp.	2	2	3
50 deg. C.	9	10	14
80 deg. C.	14	14	16
Chlorimet 3			
Room temp.	2	2	3
50 deg. C.	9	11	13

Other data at the higher concentrations of acid indicate that these alloys are also satisfactory up to the anhydrous condition and at relatively high temperatures.

Chlorimet 2 is a high nickel-molybdenum alloy with a nominal chemical composition of 63 percent Ni, 32 Mo, 3 Fe max. and 0.10 C. Chlorimet 3 is also a nickel-base high alloy with a nominal chemical composition of 60 percent Ni, 18 Cr, 18 Mo, 3 Fe max. and 0.07 C max. Both of these high strength alloys are produced in the cast form only and they are machinable. At present, production is limited to pumps and valves although special castings are made in this alloy. In general, Chlorimet 2 should be used under reducing conditions and the chromium-bearing Chlorimet 3 when oxidizing conditions exist.

The Chlorimets are relatively high-cost materials because of their high alloy content and the close metallurgical control needed during production. This generally means that the service conditions must be severe before they are utilized in preference to other hydrofluoric acid resisting alloys such as Monel, Inconel, Durimet-20, and others. The presence of additional corrosives, high temperatures and/or aeration may preclude the use of these other alloys, and often dictates the selection of one of the Chlorimets. Experience to date on Chlorimet 2 is somewhat limited. Chlorimet 3 is being used to a greater extent for many services. For instance, many Chlorimet 3 pumps are in service handling 6 percent aerated hydrofluoric acid at 90 deg. F. where complete freedom from metallic pick-up is essential. This

(*Continued*)

alloy was selected when a test program disclosed that other alloys did not meet the specified requirements.

Chlorimet 3 is also being utilized in the manufacture of hydrofluoric acid where fluorspar is treated with concentrated sulphuric acid at elevated temperatures. The conditions of service are sufficiently oxidizing to render many other materials unsuitable. Chlorimet 3 pumps handling a mixture of hydrofluoric acid, sulphuric acid and water with a fine abrasive material in suspension at approximately 35 deg. C. are presently giving much better service than the other alloys previously used. It is expected that other equipment from Chlorimet 3 should also provide extended life over Durimet-20, Inconel and Monel, which were previously utilized.

High-Silicon Irons

Walter A. Luce, *Duriron Co., Dayton, Ohio*

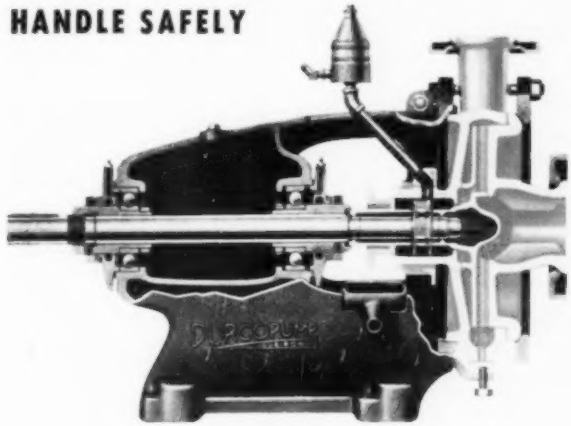
The high-silicon iron alloys are attacked by hydrofluoric acid and must not be applied where this acid or other forms of the free fluoride ion are encountered. It has been definitely established that even small percentages of the fluoride ion can cause rapid failure of chemical equipment.

Hydrofluoric acid is one of the few exceptions to the fact that the high-silicon irons, such as Duriron and Durichlor, are the most universally corrosion resistant alloys known. Duriron has a nominal chemical composition of 14.5 percent Si, 0.75 Mn and 0.90 C while Durichlor has 3.0 percent molybdenum in addition to the above analysis for Duriron. These alloys are supplied in the cast form only but are available in various forms of chemical equipment such as pumps, valves, jets, fans, ejectors, pipe and so forth. Due to their high hardness, the high-silicon irons can be machined only by grinding.

There is some indication that the high-silicon irons can be applied on certain compounds containing fluorine if this element is combined as a stable radical. For example, preliminary testing of Duriron in various fluoborate plating solutions indicates a satisfactory service life. Hydrofluosilicic acid may also fall in this same category. However, it must be emphasized that careful study is mandatory before such alloys can be utilized even when fluorine is thoroughly combined in the described manner. Thorough plant and laboratory testing is recommended prior to the trial use of Duriron equipment in such instances. —*End*

HERE'S A PARTIAL LIST....

OF THE CORROSIVES THIS PUMP CAN HANDLE SAFELY



A Durcopump can handle and resist practically any corrosive in commercial use today.

The reason—The wet end parts of Durcopumps are available in twelve different corrosion-resistant alloys. *Patterns are rigged and mounted, ready to produce any one of the required castings in our own foundry.* Foremost among these are the exclusive Durco alloys Duriron, Durichlor, Durimet and Chlorimet. Other alloys are Nickel, Monel, Inconel, Ni Resist, Nickel Cast Iron. Durco will help you select the alloy that will solve your corrosive pumping problem.

Further, the mechanical features of the Durcopump are a result of over 35 years of Chemical Pump Engineering. They assure lasting efficiency.

Model 40 Durcopumps are available in capacities up to 2000 g.p.m. for heads up to 230 feet. But, why not get the complete story. Send for the new Durcopump bulletin. Just fill out the coupon and mail it today.

Acetic acid, all strengths
Alum
Aluminum sulfate + H_2SO_4
Ammonium chloride
Ammonium hydroxide
Ammonium sulfate
Arsenic acid
Barium chloride
Benzoic acid
Black liquor
Cadmium sulfate
Calcium bisulfite
Carbonic acid
Cellulose acetate
Chloroacetic acid
Chlorinated water
Chromic acid
Copper sulfate
Fatty acids
Ferric acetate
Ferric ferro-cyanide
Ferric sulfate
Ferrous sulfate
Formaldehyde
Formic acid
Hydrochloric acid
Hydrofluosilicic acid
Hydrogen peroxide
Hypochlorite bleach
Lead acetate
Lead nitrate
Maleic acid
Malic acid
Manganese chloride
Mercuric chloride
Mixed acid
Nickel chloride
Nicotine sulfate
Nitric acid, all strengths
Nitrobenzene
Oleic acid
Oleum
Oxalic acid
Phenol
Phosphoric acid
Phthalic acid
Potassium hydroxide
Potassium sulfate
Pyrogallic acid
Pyroligneous acid
Sodium bisulfite
Sodium ferricyanide
Sodium hydroxide
Sodium sulfite
Stannic chloride
Stannous chloride
Stearic acid
Sulfite liquors
Sulfur dioxide
Sulfuric acid
Sulfurous acid
Tannic acid
Tartaric acid
Vinegar
Zinc chloride
Zinc sulfate

DURCO Adv. 93-GM

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DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON CO., INC., DAYTON 1, OHIO

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Company ....

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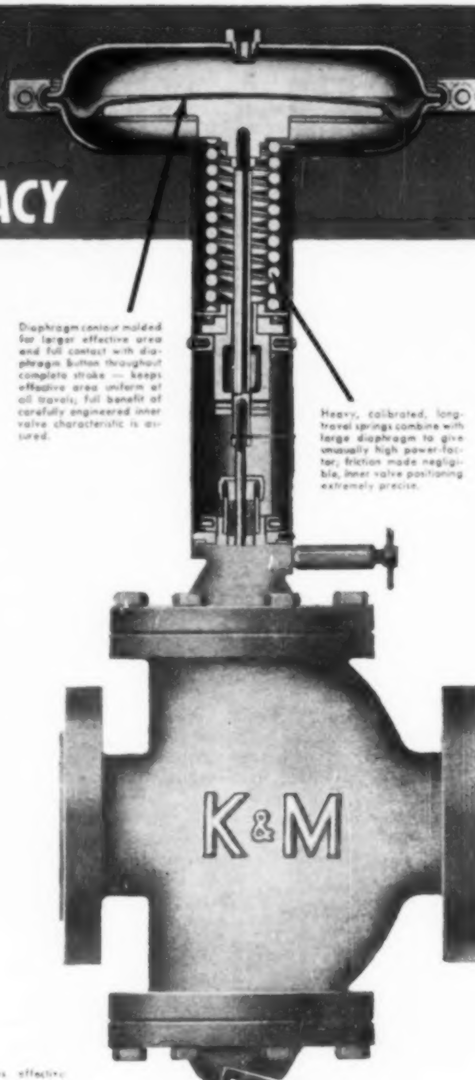
Here is the Diaphragm Motor with GREATER POWER for GREATER ACCURACY

The far-advanced K&M Diaphragm Motor is designed for the more exacting needs of modern process industries. An unusually high power-factor is obtained by the carefully-engineered relationship of large effective diaphragm area and heavy, calibrated spring; friction is negligible, inner valve positioning more precise. The diaphragm is specially designed for constant affinity with the button contour; this assures a uniform effective area throughout the complete valve stroke, thus more uniformly accurate control. The unusually large area of the diaphragm in relation to the valve size also helps assure more precise control.

K&M motors are available for direct action or reverse action without change in effective area or stroke.



Diaphragm contour molded for larger effective area and full contact with diaphragm button throughout complete stroke — keeps effective area uniform at all travels; full benefit of carefully engineered inner valve characteristic is assured.

Heavy, calibrated, long-travel springs combine with large diaphragm to give unusually high power-factor; friction made negligible, inner valve positioning extremely precise.

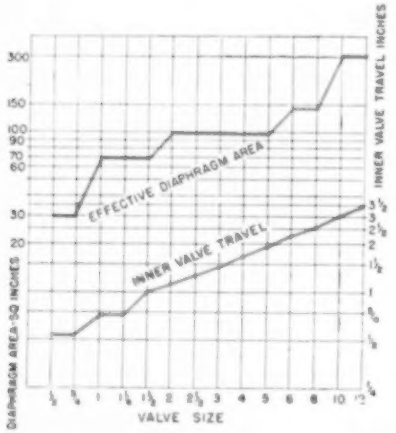


Chart shows effective diaphragm areas and valve travels on K&M Series 1200 and 1400 Kontrol Motor Diaphragm Valves.

KONTROL MOTOR
KIELEY & MUELLER
NORTH BERGEN, N.J.
ESTABLISHED 1879

You should have a copy of Kieley & Mueller Catalog 47. Over 100 pages describe the entire modern K&M line: Kontrol Motor Diaphragm Valves, Kontrol Master Liquid Level Controls and Pressure Pilots and related equipment for steam, gas, air, oil and liquid service. Please request on your business stationery.

Names in the News

MAN OF THE MONTH

A. E. Buchanan, Jr.

It is with considerable pleasure and satisfaction that *Chemical Engineering* pays tribute this month to a former member of its editorial staff. "Buck" Buchanan's career has always been watched with interest by this office. Now Du Pont has just promoted him to the post of assistant general manager of the company's rayon department.

Andrew E. Buchanan, Jr., was born in Philadelphia Nov. 8, 1896. After graduation from Lehigh University in 1918 as a chemical engineer he went to work for Du Pont and served in several World War I smokeless powder plants. In 1921 Mr. Buchanan left Du Pont to join the editorial staff of *Chem. & Met.* Two years later he returned to his alma mater as a member of the administrative staff. After four years at Lehigh he returned briefly to his editorial duties in New York. Lehigh again claimed him, this time for nearly eight years.

In January 1936 he accepted the position of research director for Remington Arms Co. 1939 saw him made technical director. The company's expanded military business made him assistant production manager in 1941 and then division production manager for Remington plants in Connecticut, New York and Ohio. When he was transferred to Du Pont in 1944 he was manager of Remington's technical division.

His present Du Pont career has all been with the rayon department: first assistant, then manager (1947) of the department's technical division; in March of this year he became acting assistant manager; and now he is assistant general manager of the whole department.

He is a trustee of Lehigh University and has long been identified with the American Institute of Chemical Engineers. His principal current interests are polymers and people. He is an ardent yachtsman who has been temporarily beached by the pressure of other duties.

Dr. and Mrs. Buchanan (he received an honorary doctor of engineering degree from Lehigh this year) live in Kennett Square, Pa. They have one son and three married daughters.

Edward F. Degering, professor of chemistry and director of research projects at Purdue University, has been named assistant chairman of chemistry and chemical engineering at Armour Research Foundation of Illinois Institute of Technology.

E. F. Degering

T. H. Rider

Theodore H. Rider has been promoted to the position of director of research of Lever Brothers Co., Cambridge, Mass.

L. P. Holladay has been transferred from Du Pont's chlorine products division in Wilmington, to Niagara Falls as assistant control superintendent. **R. P. Genereaux** has been appointed manager of the Du Pont engineering service division, formerly known as the industrial engineering division, succeeding **H. W. Oggenfuss,** who was appointed associate director of the machine development section of the development engineering division.

Louis Ware, president of International Minerals & Chemicals Corp., sailed for Europe last month for a two-month business trip.

William J. Peppel has been appointed director of Jefferson Chemical Co., Inc.'s new Austin laboratories and **Charles H. Novotny** has been named manager of the laboratories. Assisting Dr. Peppel in the direction of the various divisions at Austin will be: **John W. Waldron,** assistant director of the laboratories and director of the process development division; **J. David Malkemus,** director of the products application division; **Granville W. Burtt,** director of the analytical testing division; and **Martin M. Padwe,** librarian.

E. M. Ford

R. B. Semple

E. M. Ford has been elected chairman of the board of directors, Wyandotte Chemicals Corp., effective September 1. Elected to succeed Mr. Ford as president and director of the corporation, was **Robert B. Semple,** director of Monsanto Chemical Co.'s general development department.

R. A. Emmett, Jr., has been made a special assistant to the general manager of Detrex Corp. to supervise material control, production scheduling, inspection, and safety. **J. Doyle Hamacher** has been made superintendent of the equipment manufacturing plant. He will also retain his previous title and duties as company plant engineer.

Irwin L. Gold and **Robert E. Kegan** have joined the Air Force Munitions Branch, Army Chemical Center, Md., as chemical ordnance engineers. **Paul T. Geckle** has joined the Analytical Branch as a chemist.

Thornton C. Jesdale and **Chester L. Jones** have been appointed assistant general managers of sales for the Merrimac division of Monsanto Chemical Co.

Leland I. Doan, president of the Dow Chemical Co. has been appointed to the board of directors of the Saran Yarn Co., Odenton, Md.

Alan F. Clifford has been named assistant professor of chemistry at Illinois Institute of Technology, effective September 1. For the past two years Dr. Clifford has been serving

(*Continued*)

as instructor at the University of Delaware.

S. G. Ketterer has been appointed Philadelphia district sales manager by Schutte and Koerting Co., Philadelphia, Pa.

V. I. Komarewsky, professor of chemical engineering and director of the catalysis laboratory at Illinois Institute of Technology has been invited to speak before the Danish Chemical Society in Copenhagen next month.

Colin G. Fink, professor of chemical engineering at Columbia University, received emeritus designation on July 1.

J. Eldred Hedrick of New York, senior technologist of the Shell Chemical Corp., has been appointed a professor of chemical engineering at Cornell University. Dr. Hedrick joined the staff of Cornell's school of chemical and metallurgical engineering last month.

Edward J. Fradkin has recently accepted a position with the Chemical Construction Corp. He is doing work in gas desulphurization at their Linden, N. J., pilot-plant.

Robert L. Savage, Thomas J. Walsh and **Robert C. Weast** have been promoted to associate professorships of chemistry and chemical engineering at Case Institute of Technology, Cleveland. **George W. Blum** has been named assistant professor.

F. C. King has recently been named assistant manager of the General Petroleum Corp.'s engineering department at Los Angeles.

Gray King, formerly associated with Rayonier, Inc., has joined Puget Sound Pulp & Timber Co. at Bellingham, Wash., as assistant technical director in charge of research.

Francis K. McClune is the newly appointed assistant general manager of the General Electric nucleonics department, Richland, Wash.

William J. Harshaw, president of the Harshaw Chemical Co., was awarded the honorary degree of doctor of science on June 15, by Western Reserve University.

John J. Padbury of Stamford has been named group leader of the polymers and resins group in the research division of the American Cyanamid Co.'s Stamford research laboratories.

Games Slayter, vice president and research director of Owens-Corning Fiberglas Corp., received the honorary doctor of engineering degree from Purdue University at his alma mater's 91st commencement exercises in Lafayette, Ind., on June 19.

E. W. Riblett has been transferred from the New York office of the M. W. Kellogg Co. to Jersey City, N. J., as associate director of the petroleum and chemical research laboratory.

R. F. Baker, general manager of the domestic producing department of the Texas Co., has been elected a vice president in charge of domestic producing operations. He succeeds **R. Ogarrio** who was made chairman of an executive producing committee.

Murlin T. Howerton will become instructor in chemical engineering at the University of Notre Dame in September.

B. E. Harris has been elected a vice president of Ford, Bacon & Davis. Mr. Harris has been with the firm since 1923, having had charge of many large projects in the fields of design, construction, valuation and reports.

Robert L. Richards has been named general manager of Du Pont's rayon department. He succeeds **Benjamin M. May,** who retired in June after more than 46 years with the company.

Robert Maccoun has joined the overseas staff of the office of Graham W. Parker, technical and industrial consultants, New York.

R. W. Cook, deputy manager of the U. S. Atomic Energy Commission's Oak Ridge operations office, has been appointed acting manager.

Earl Erich, a recent graduate of Muhlenberg College, has accepted a position in the research laboratories of the Atlas Mineral Products Co. at Mertztown, Pa.

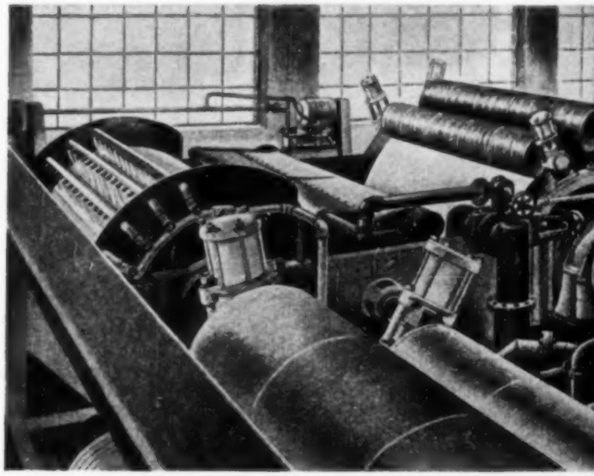
Ellsworth E. Kimmel, an expert in coal-tar chemicals, has joined Koppers Co., Inc., as assistant to the technical advisor for the chemical division.

R. J. Devereaux of the B. F. Goodrich Co. has been elected president of

(*Continued*)

as you were in 1900

Paper bleaching was a slow
and uncertain process
at the turn of the century



as you are today

Bleaching with liquid chlorine in a
modern mill is fast, efficient, precise

...with pioneering aid from Niagara Alkali

An old industry with young and progressive ideas, the paper industry has made tremendous strides forward since 1900—in the speed and efficiency of its methods and the quality, variety and utility of its products,

Niagara's pioneer production in America of liquid chlorine and caustic soda helped to make such advances possible in the paper industry—and in the textile, soap, glass and other fields. For pioneer quality and service in electro-chemical products look to Niagara.

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60 East 42nd Street, New York 17, N. Y.

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the Washington (D. C.) Rubber Group for the coming year.

Morgan Jones has joined Maneely Chemical Co., Wheatland, Pa., as plant manager.

Raymond L. Copson has been appointed director of research of the Mutual Chemical Co. of America with headquarters in Baltimore. Dr. Copson was formerly director of research for the Rumford division of the Heyden Chemical Corp.

R. L. Copson

T. M. Ware

Thomas M. Ware has been appointed chief engineer of International Minerals and Chemical Corp., Chicago, Ill., to succeed **James H. Barr** who is retiring after 38 years. Mr. Ware will supervise construction and layout of manufacturing and mining operations.

Otto Eisenschiml, president, Scientific Oil Compounding Co., will receive the Honor Scroll Award of the American Institute of Chemists at a meeting of the Chicago Chapter on October 7.

Erwin H. Amick, Jr., associate professor of chemical engineering at Columbia University, has gone to Germany to serve as a technical consultant to the Department of the Army in connection with the decartelization of I. G. Farben Industries.

William W. Hopwood has been elected vice president of Hagan Corp., Pittsburgh combustion and chemical engineering firm, and its subsidiaries, Calgon, Inc., Hall Laboratories, Inc., and the Buromin Co.

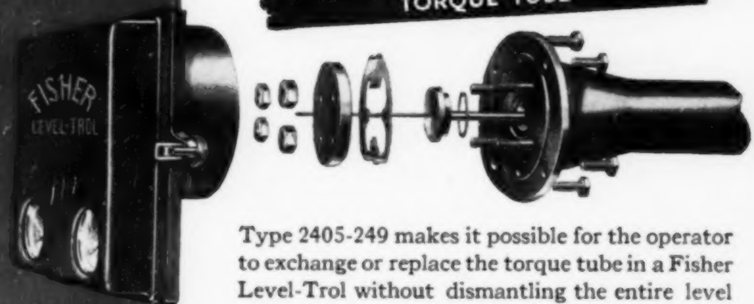
R. E. Kent has joined the research staff of Chas. Pfizer & Co., Inc., Brooklyn, N. Y. He was formerly with the plastics department, E. I. du Pont de Nemours, Arlington, N. J.

James T. Power, director of development for Hercules Powder Co.,

(Continued)

FISHER LEVEL-TROL

REMOVABLE, REPLACEABLE TORQUE TUBE



Type 2405-249 makes it possible for the operator to exchange or replace the torque tube in a Fisher Level-Trol without dismantling the entire level controller or breaking into pressure piping. All Fisher Level-Trols are furnished with this improved feature.

ONLY ONE CONTROL FOR PROPORTIONAL BAND AND SPECIFIC GRAVITY ADJUSTMENT

Type 2405 Level-Trol Pilot

Type 2405-249 Level-Trol with top and bottom screwed equalizing connections

As easy as tuning a radio. Control knob readily accessible, provided with calibrated scale to indicate setting. Pilot is entirely pneumatic in operation. No intervening links or mechanical joints. High tensile iron, pressure tight, weather proof case with hinged gasket sealed cover.

Write today for Bulletin F-2

FISHER GOVERNOR COMPANY, MARSHALLTOWN, IOWA

Wilmington, has retired after 42 years of service in the explosives and chemical industries.

William H. Burkhart, who has been director of manufacture for Lever Brothers Co., has been promoted to vice president in charge of manufacturing and traffic.

Brehon Somervell, president of Koppers Co., Inc., has been elected a member of the board of directors of the Carborundum Co.

W. K. Menke, assistant general manager of sales for the Merrimac division of Monsanto Chemical Co., has been named director of the company's general development department in St. Louis.

Charles H. Sommer, Jr., and **David L. Eynon** have been appointed assistant general managers of the organic chemicals division of Monsanto Chemical Co., St. Louis. **Paul G. Marsh** succeeds Mr. Eynon as production manager for the company plants at Monsanto, Ill., and Nitro, W. Va.

Leo K. Rochen and **Semour Blau** have been elected president and vice president, respectively, of Arenol Chemical Corp., Long Island City.

M. M. Renfrew is now head of the chemistry department of the research laboratories of General Mills, Minneapolis. He was formerly in the chemical division, plastics department, E. I. du Pont de Nemours & Co., Arlington, N. J.

Harry W. Davis has been named head of the chemistry department at the University of South Carolina.

Joseph C. Hess, Jr., has been elected vice president in charge of production for Leeds & Northrup Co. He succeeds **W. R. Coley** who retired after 43 years with the company.

A. H. Kleinfeldt has been made assistant to the technical director of Reynolds Metals Co., Louisville.

D. Roy McCullagh has been appointed a member of the Sterling-Winthrop Research Institute. Dr. McCullagh will serve as director of the Institute's biochemistry laboratories in Rensselaer, N. Y.

Mingo-Kao Yen has been appointed research associate at the New York University College of Engineering

(Continued)

and will work on titanium and chromium alloys.

David J. Price, chemical engineer and specialist in the causes and prevention of industrial dust explosions and farm fires, has retired from the Bureau of Agricultural and Industrial Chemistry.

Hugh Pickering has joined the staff of Evans Research and Development Corp., as a research assistant in the physical chemistry research section. **Charles S. Block** has also joined as research assistant in the resins and plastics section.

Paul M. Gross, vice president, dean of the graduate school, and professor of chemistry at Duke University, was named president of the Oak Ridge Institute of Nuclear Studies by the organization's board of directors in June.

Paul L. Howard has been appointed to the staff of the National Bureau of Standards, where he will conduct research in the electrochemistry laboratory, specializing in new types of primary and secondary batteries.

George P. Gabriel has accepted a position as engineer with the Atlas Mineral Products Co., Mertztown, Pa.

James R. Cameron, chemical engineer, has joined the research staff of Battelle Institute, Columbus, Ohio, where he will be engaged in research in nonferrous metallurgy.

Robert E. Cullen, director of acetate sales in the Du Pont company's rayon department, has retired after more than 34 years in the Du Pont organization.

Carl T. King, production manager of Monsanto Chemical Co.'s plastics division, has been appointed to the position of assistant to the general manager of the division. **Robert K. Mueller** has been promoted to the post of production manager.

Gerald Johnson, G. Sidney Sprague and **Louis Quin** have joined the research staff of the American Cyanamid Co. at its Stamford Research Laboratories. **Elwood Murray, Samel Crecilius** and **John F. Davis** have joined the surface coatings group in Stamford.

Vincent V. Lindgren and **B. R. Putnam, Jr.**, have joined the new prod-

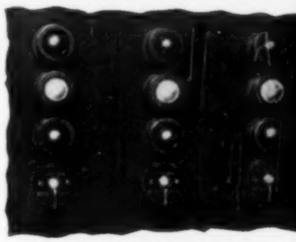
(Continued)

Three 3-Light Visularms Mounted in a Horizontal Row with Back Fed Conduit Arrangement. Rear View of Panel One Cover Removed.

Explosion-Proof Visularm CONDULETS*

safeguard continuous production
by instant warning of abnormal conditions

1. **Pilot lights** give visual indications of normal and abnormal temperature, pressure, liquid level, speed, load or other conditions.
2. **Bell or howler** can be used to give an audible signal. A single bell or howler can serve any number of *Visularms.*
3. **Flashing light** instantly directs attention to the proper control station.
4. **Reset-Test Switch.** "Reset" position silences audible signal and changes flashing light to steady until normal operation is restored. "Test" position permits periodic check of each element in the *Visularm.*
5. **Compact and easy to install.** Occupies little space on the control panel. Only requires round drilled holes.
6. **Accessible** . . . . all actuating devices are on a factory-wired, jack-mounted plate which can be quickly removed for servicing and a spare can be inserted to maintain operation.
7. **Flame-tight threaded joints** on all openings . . . give maximum protection with quick and easy access.
8. **Two-light and three-light** *Visularms* are available; any number can be mounted in either vertical or horizontal rows on a control panel. *Listed on new Pages 12L through 12P, Section 85, Condulet Catalog 2500.*



Front View of the Panel Illustrated Above with Three 3-Light *Visularms* Mounted in a Horizontal Row.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

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uct development department of the American Cyanamid Co. Dr. Lindgren, who has been associated with the company for the past three years in its Stamford research laboratories, will devote his time to new product development activities. Mr. Putnam, who has been engaged in engineering development in the company's technical department, will be concerned with market research.

Francis B. Thorne and **John L. Patterson** have been named assistant superintendents of the chemical plant, Eastman Kodak Co., Rochester.

Stanley H. Jury has accepted the position of assistant professor of chemical engineering at the University of Tennessee, Knoxville.

Alan F. Clifford has been named assistant professor of chemistry at Illinois Institute of Technology.

OBITUARIES

Ernest M. Symmes, 60, Hercules Powder Co. executive, died in Wilmington June 16.

Otto A. Sjostrom, 81, for 34 years research chemist at Corn Products Refining Co., Argo, Ill., and former president of the Chicago Chemists Club, died June 16.

William F. Anderson, 59, engineer in the chemical department, Corn Products Refining Co., Argo, Ill., died June 17.

Andrew M. Fairlie, 72, consulting chemical engineer of Atlanta, Ga., died June 17.

Charles J. Brand, 70, retired executive secretary and treasurer of the National Fertilizer Association, died in Washington June 29.

John Hart, traffic manager and a director of the former Grasselli Chemical Co., died at his home in Cleveland June 30.

Edward W. Freundt, 47, manager of the chemical division of Armour & Co., died in Seattle, July 3.

Samuel Alsop, Sr., president and founder of Alsop Engineering Corp., died in Madison, Conn., July 7.

Fritz J. Hansgirg, 58, internationally-known chemical engineer and inventor of the Hansgirg magnesium extraction process, died in New York July 23.

INDUSTRIAL NOTES

Walsh Refractories Corp. has moved its administrative offices to 101 Ferry St., St. Louis 7, Mo.

Borg-Warner Corp., Chicago, has made John A. Lauck vice president of its Pesco Products division. D. A. Sutherland has been made the division's industrial relations manager.

Electric Industrial Truck Association has moved its executive offices to the Beury Bldg., 3701 North Broad St., Philadelphia 40, Pa. W. V. C. Brandt is now managing director, secretary-treasurer of the association.

Calumet and Hecla Consolidated Copper Co., Detroit, has opened a southeastern district sales office in Atlanta, Ga., for its Wolverine Tube division.

Baker-Raulang Co., Cleveland, Ohio, has appointed John A. Matousek manager of manufacturing for its Baker Industrial Truck division. E. H. Remde has been made advisor to the president on engineering and manufacturing; H. A. Schultz has been made managing engineer; I. L. Young has been made general superintendent.

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has made Don W. Williams manager of its Cleveland branch office.

Reynolds Metals Co., Louisville, Ky., has established a chemical division to handle its line of specialties used by the chemical industry. I. P. Macauley, vice president, will head the new division with headquarters in New York City.

Hamilton-Thomas Corp., Hamilton, Ohio, has made Grant E. Scott, Jr., assistant sales manager of its Klipfel Valves, Inc., division.

Arkell & Smiths, New York, has made H. C. Peterson sales manager.

Manning, Maxwell and Moore, Inc., Bridgeport, Conn., has appointed C. F. Johnson manager of valve sales.

Hagan Corp., Pittsburgh, Pa., has put William R. Kalbach in charge of sales and service engineering in its Cincinnati district office.

Dee Co., Philadelphia, has changed its name to John R. McAusland and Co. Inc.

American Mineral Spirits Co., Chicago, has named Harold J. Coghlan manager of tank car sales in New York and New Jersey.

Archer-Daniels-Midland Co., Minneapolis, has appointed Burton W. Schroeder manager of fatty acid sales.

Rohm & Haas Co., Philadelphia, has contracted with the Ordnance Dept. of the U. S. Army to organize and operate a laboratory for basic research and development in rockets and jet propulsion. The project will be located at the Army's Redstone Arsenal near Huntsville, Ala.

W. G. Rovang & Associates, Inc., Portland, Ore., has been formed to fabricate equipment and materials for the chemical processing industries.

Timken Roller Bearing Co., Canton, Ohio, is celebrating its 50th anniversary this year.

Union Carbide and Carbon Corp., New York, has completed an oxygen distributing station and acetylene producing plant at Fargo, N. D., to be operated by its subsidiary, Linde Air Products Co.

Standard Oil Co. (New Jersey), New York, has appointed Howard W. Page as shareholders' representative for the company's affiliates in the United Kingdom. David A. Shepard will succeed Mr. Page as executive assistant to the president.

Worthington Pump and Machinery Corp., Harrison, N. J., has elected Hobart C. Ramsey to its presidency.

Hooker-Detrex Inc., Niagara Falls, N. Y., has announced plans to build a plant for manufacturing trichloroethylene in Ashtabula, Ohio.

Koppers Co., Inc., Pittsburgh, Pa., has made George W. Hooker chief engineer of its chemical division.

Lincoln Electric Co., Cleveland, has completed arrangements with the

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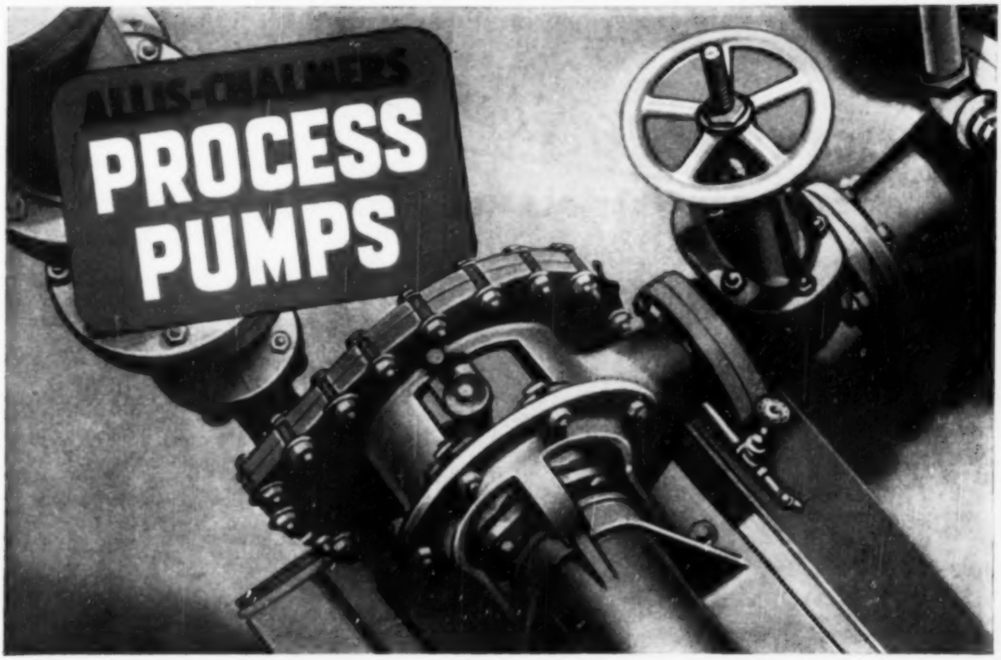

"No Replacement Parts Needed

ON ABRASIVE LIQUOR PUMP!"

SUPERINTENDENT of a midwestern processing plant says: "We pump tailings and filter solutions. Our conventional pumps required parts replacement every 6 to 10 weeks. We have *not replaced any parts* in our A-C process pumps *in 20 months*. We are replacing all our conventional pumps with A-C process pumps."

Plant after plant reports similar experiences. A-C process pumps are designed and built stronger especially to stand up under the added wear of suspended abrasives, mild corrosives or both. Such features as stuffing box on suction side . . . double volute casing . . . extra thick sections . . . closed impeller . . . separated wearing parts . . . and adjustable clearance between impeller and wearing plate give you added life and amazingly lower maintenance costs.

STOCKED IN 4 MATERIALS

Shipment from stock on complete pumps and all parts in aluminum-bronze, Ni-resist, 18% chrome steel and 316 stainless steel. You need not carry spare parts inventory. For complete information, see your A-C Authorized Dealer or Sales Office or write for Bulletin 08B6615. A-2737

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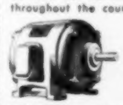

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

A-C

ALLIS-CHALMERS

Austin Co. of Cleveland for the immediate construction of a $8,-500,000 plant to be erected in Euclid, Ohio.

National Technical Laboratories has established a New York service department located at 1114 First Ave. E. D. Haller and E. C. Bowen will jointly head the department.

Upjohn Co., Kalamazoo, Mich., has opened a Philadelphia branch with Fernen E. Fox as sales manager.

Westinghouse Electric Corp., Pittsburgh, Pa., has appointed Tomlinson Fort manager of its apparatus sales department. William W. Sproul has been made sales manager of industrial products. Royal C. Bergvall has been made engineering manager of industrial products.

Eastman Kodak Co., Rochester, N. Y., has announced that Alvin H. Hartman has been made sales manager of the vacuum equipment division of its subsidiary, Distillation Products, Inc. Carl W. Herrmann has been made eastern area sales representative of the division.

Filtration Engineers Inc., New York, has named Roger G. Flaherty manager of its newly organized filtration fabrics division.

Monsanto Chemical Co., St. Louis, Mo., has appointed Herbert W. Yeagley manager of its Washington, D. C., office.

Morehouse Industries, Los Angeles, Calif., has appointed H. M. Van Horn representative for its Speedline mills in the greater Philadelphia area.

Marcus Sittenfield, consulting chemical engineer, has moved his engineering offices to the Philadelphia Stock Exchange Bldg.

Taylor Instrument Cos. has enlarged its sales staff in the Cleveland area with the addition of Benjamin Steverman and Charles Tibbits as industrial salesmen. John Grotzinger has been assigned to field engineering.

Pure Carbonic, Inc., New York, has opened a carbonic gas cylinder filling plant and dry ice warehouse in Pittsburgh, Pa.

Philipp Brothers Chemicals, Inc., New York, tendered a dinner and thea-

(Continued)

a

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Solvent oils

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- ★ add to the flow of high temperature baking enamels
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- ★ serve as a penetrating oil
- ★ provide a blending solvent to improve cold tests
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Attractive Price Range!

Made in several grades, of which this specification is typical

PICCO HI-SOLV OIL NO. 473

Distillation	220°C (430°F.) to 270°C (520°F.)
Specific Gravity / 15.5	0.925—0.935
Color (Gardner Holdt)	G-4
Mixed Aniline Point (ASTM)	33°C.
Flash Point	180°F. (COC)

Other grades of wider or shorter boiling range, varying colors, gravity, and degree of refinement are available.

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Will you please send me a sample of PICCO HI-SOLV OIL.
We are interested in this for..........................

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eastern and midwestern regional manager of Pabco's insulation division with headquarters in New York.

Link-Belt Co., Chicago, has appointed John D. Riley district manager at Newark, N. J.

Monsanto Chemical Co., St. Louis, Mo., has appointed W. Kenneth Menke assistant general manager of sales for its Merrimac division.

Kieley & Mueller, Inc., North Bergen, N. J., has appointed the Van Hala Industrial Sales Co., Cleveland, as its exclusive sales representative in the Cleveland area.

Brown Fintube Co., Elyria, Ohio, has appointed Laurence C. Johnston district sales manager with headquarters in New York.

Diamond Alkali Co., Cleveland, has appointed Ralph P. Stilphen special technical sales and service representative for the protective coating field.

Innis, Speiden & Co., New York, has acquired as a wholly-owned subsidiary the E. S. Browning Co., Inc., of San Francisco and Los Angeles.

Peabody Engineering Corp., New York, has appointed A. P. Olches chief engineer. He will direct engineering and research for his concern.

Kieley & Mueller, Inc., North Bergen, N. J., has appointed John G. Kirkpatrick as exclusive sales representative in Pennsylvania, New Jersey and New York.

Pennsylvania Salt Manufacturing Co., Philadelphia, has appointed Albert H. Clem assistant manager of sales of its special chemicals division.

Magna Manufacturing Co., Inc., New York, has appointed Dowdy Brothers, Philadelphia, as its representative in the Philadelphia area.

Pennsylvania Salt Manufacturing Co., Philadelphia, has appointed Richard A. Weppner to the sales staff of its special chemicals division.

Mathieson Chemical Corp., New York, has named D. W. Drummond vice president, director of industrial chemical sales. S. L. Nevins has been made vice president, director of agricultural chemical sales. J. O.

(Continued)

Logan becomes sales manager, industrial chemicals; R. J. Quinn, assistant sales manager, industrial chemicals; L. P. Thomas, southwestern sales manager, industrial chemicals; J. S. Whittington, sales manager, agricultural chemicals.

Clark Bros. Co., Inc., Olean, N. Y., has promoted A. G. Van Campen from sales engineer in its New York office to district manager of its Chicago office. R. C. McDonald will replace Mr. Van Campen. T. P. Latimer has joined the company's turbo-machinery sales division.

Koppers Co., Inc., Pittsburgh, Pa., has opened a sales office for its chemical division at 250 Stuart St., Boston, Mass. J. W. LaBelle has been named manager.

Chas. Pfizer & Co., Inc., Brooklyn, has appointed Charles P. Walker, Jr., general sales manager. Frank F. Black becomes acting manager of the medicinal sales division.

Esso Standard Oil Co., New York, has appointed B. L. Ray assistant general manager of its marketing department. A. R. Martin has been made acting manager of the cost and operations division.

Glidden Co., Cleveland, has made James C. Rankin general manager of its feed mill division in Indianapolis. C. Kenneth Shuman has been appointed manager of research and development.

Edwal Laboratories, Inc., Chicago, has expanded the duties of Phil Malmstedt, sales manager of its photographic division, to include fine chemicals, especially photographic and diazotype materials. H. C. Stecker of the chemical sales division has resigned.

Hamilton-Thomas Corp., Hamilton, Ohio, has elected E. E. Baker vice president of its public works pump division and W. G. Rosendahl vice president of its machine tool division.

Combustion Engineering-Superheater, Inc., New York, has made Walter Springe division manager in Kansas City. C. J. Grossi has been made district manager, Tulsa, Okla. T. F. McMahon has been transferred from the Philadelphia office to Kansas City as district manager. W. J. Woodruff becomes district manager of the St. Louis, Mo., office. —*End*

Axial flow *Thru* Epicycloidal Rotors ~ *Compact* ... *Simple* ... *Positive* ... *Economical*

YEARS of research, refinement and service have preceded the introduction of our latest product—the STANDARDAIRE BLOWER. It features the axial flow principle in a positive displacement unit of sturdy, compact design. This all-purpose blower gives the greatest air or gas output per pound of weight that has ever been achieved in a positive displacement type blower. The blower is highly responsive to load demands—it's overall efficiency is also high, and for a given output the power consumption is low. Another factor of importance—the Standardaire Blower will deliver absolutely clean air because of its unique oil sealing arrangement. Consult with our engineers for specific details. ***Write The Standard Stoker Company, Inc., Dept. A-10, 370 Lexington Avenue, New York 17, New York.***

Important Features of Standardaire Blower

1. Handles gas or air under pressure or vacuum.
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CONVENTION PAPER ABSTRACTS

Contents

MAINTENANCE

. . . Preventive Medicine

R. W. Tryon

Preventive maintenance might be described as any system which, in recognition of a possible failure, attempts to alleviate its cause. Training of plant operators in the handling of equipment, training of mechanics in the performance of their work, and the application of specialized knowledge in the field of design and maintenance all come within the scope of the term.

Our company has a highly developed system for exchanging information between refineries and technical groups with respect to preventive maintenance practices. With adoption of complex modern processes, it is necessary to train future plant operators long in advance of completion of units they are to operate. Process engineers conduct classes in the theory of the process involved. Key operators are sent as observers to another plant where the process is in use. As construction proceeds, groups of operators visit the site to trace the lines and circuits and to see the interior of the equipment. These and succeeding steps are a part of the concept of preventive maintenance.

The question as to who should do the lubrication of processing equipment is important in maintenance. One of our plants has prepared a lubrication manual for each of 65 operating units, the purpose of the manual being to define responsibility for every lubrication requirement of these units. Broadly speaking, the booklet sets forth the respective duties of (1) the operating personnel, (2) the several mechanical departments.

As to pumps and drivers: Esso's larger plants have 4,000 to 5,000 pumps of centrifugal and reciprocating types. Pump records are kept. These include manufacturers' data and a running history on repairs and replacements. Records are studied by the mechanical engineering department, which translates findings into improved specifications. New materials and experimental changes are constantly being tried on pumps where service is difficult.

The use of gas engine-driven compressors has reached the point where their number and importance requires a systematic maintenance approach. In one refinery, all units are checked on a 1,000-hr. schedule, the overhaul involving complete dismantling and replacement of necessary parts.

Modernization of mechanical facilities has involved the purchase of a large number of motorized units such as bulldozers, cranes and lift trucks, as well as a fleet of cars to transport supervisors. The proper maintenance of these and other machines offers a good field for preventive maintenance.

Although cathodic protection of pipelines has been in use for 15 years, its application in Esso refineries started only two years ago. The practice today is to install most pipe on overhead supports, and to relocate piping aboveground on a program basis. However, the latter program is expensive, and cathodic protection is being demonstrated as competitive in some instances. A typical payout is three years in one refinery, where soil conditions are quite corrosive.

Gunite has been found to furnish one of the most successful methods of protecting storage tanks from internal corrosion but the application of gunite is not favored for badly deteriorated tanks because the strength of the tank to carry the gunite must be considered. Reinforced gunite is now definitely favored, inasmuch as some of the early unreinforced installations have spalled.

R. W. Tryon, Esso Standard Oil Co., before 14th Midyear Meeting, American Petroleum Institute, Houston, Apr. 4-7, 1949.

INVESTMENT PLANNING

. . . Venture Profit

John Happel & R. S. Aries

The selection of new projects for chemical industrial expansion could be aided today by a method which takes into account risk and taxes. As a means for computing the attractiveness of new plans, it is proposed that new ventures be compared on the

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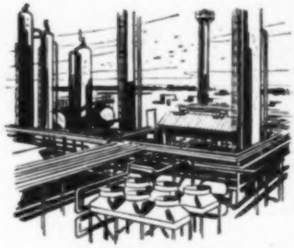
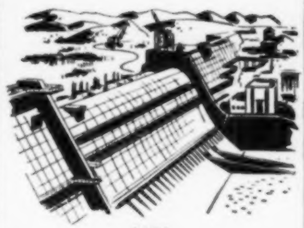

GASOLINE PLANTS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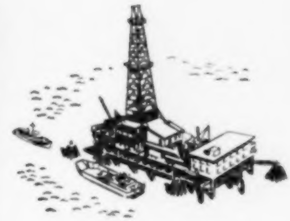
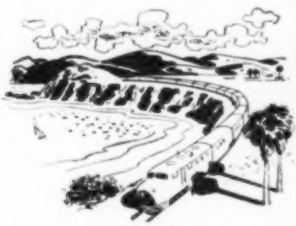

OFFSHORE PLATFORMS


BRIDGES


HIGHWAYS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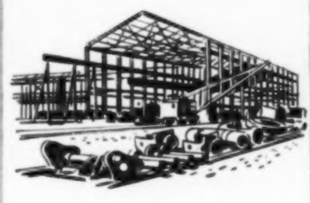
CHEMICAL PLANTS


MILITARY INSTALLATIONS

Convention Papers, *cont.* . .

basis of maximum additional profit above a predetermined rate of return consistent with the risk involved. The additional profit, which is the motive for attracting venture capital to new enterprises, may be designated as "venture profit" to distinguish it from profit usually expected in the normal conduct of business. The relationship of profit to the other considerations in a project may be expressed in a simple formula.

Let the duration of the project be assumed to be 10 years, and salvage value at the end of this period be negligible. For simplicity, it is also assumed that interest on capital investment may be neglected. By capital is intended the capital invested in equipment alone and is considered as being received annually over the entire period. The tax rate is taken as 38 percent. With these assumptions, the net profit P is calculated, based on the capital investment I in dollars, and gross yearly earnings R in dollars (i.e. sales realization less costs, insurance, etc. but before deducting income tax and depreciation.) The taxable income will then be $(R - 0.1\,I)$. The tax is then $0.38\,(R - 0.2\,I)$, and subtracting the two you have

$$P = 0.62\,R - 0.062\,I \qquad (1)$$

The annual rate of return on investment expressed as percent is:

$$p = 100\,P/I \qquad (2)$$

Inasmuch as a going concern will already have its funds invested, the new proposition considered must deliver sufficient profit to justify the risk involved *in addition to* satisfying the base return which the capital had been paying. This base return may be called P_1 and the corresponding rate, p_1. Venture profit, V, will then be expressed as follows:

$$V = P - P_1 = 0.62R - 0.062\,I - p_1 I/100 \qquad (3)$$

In the evaluation of new projects, the one showing the highest venture profit will be the most attractive.

This method amounts to comparing the rate of return on different amounts of capital at different rates of interest but at the same risk. It may be applied to decide between alternative projects or various types of plant design.

When applied to project analysis, each possible venture should be analyzed as to income over a definite period. This analysis will include market research on prices, probable competition, and demand, etc. While it is not often possible to calculate exactly, reasonable limits can usually be assigned. Once these values are estimated, they may be substituted in

(*Continued*)

the formula, which will select the project most economically feasible.

Other methods previously used have definite disadvantages from which the venture profit method escapes. These methods are:

1. "Payout time" method which calculated the time required for gross yearly earnings to equal the investment:

$$T = I/R$$

where T is the time in years.
This method is quite easy to use because it disregards all complicating factors. The objection to it, however, is that it does not take into account the fact that a large investment at an attractive rate of return is more desirable than a smaller one at the same rate.

2. The second method, the "cash position" system, allows for this difficulty, for it calculates the net increase in total assets over a given period of years. The project which ends up with the largest amount of capital is then indicated to be the preferred one. The cash position method has the disadvantage that a large investment even at a low rate of return will show a substantial increase in total assets over a period of time. In the venture profit method, it is hoped to combine the desirable features of both older systems.

In plant designing, the engineer is often faced with a great many alternatives in solving a given design problem. The venture profit method can be used to establish the economic factors involved, provided the element of risk is constant for the projects. At other times, a fixed sales price may be assumed, at which time an operation producing minimum cost would be the best. The formula may also be expanded to take into consideration interest on investment or other factors; none of these variations, however, alter the basic considerations outlined.

In any contemplated move, then, what constitutes a satisfactory rate of return depends on a number of factors. Whether the selected return rate is determined by an engineering department or the management, such a figure must be available to the designing engineer if he is to arrive at a selection of sizes and conditions which will constitute an optimum. This method of course, will not allow for unusual competition, overloads, or unpredictable factors. These things, however, may be incorporated, if desired, into estimates to compute the equation.

Thus, while in the past values and taxes were more stable than at present, it is now found that customary

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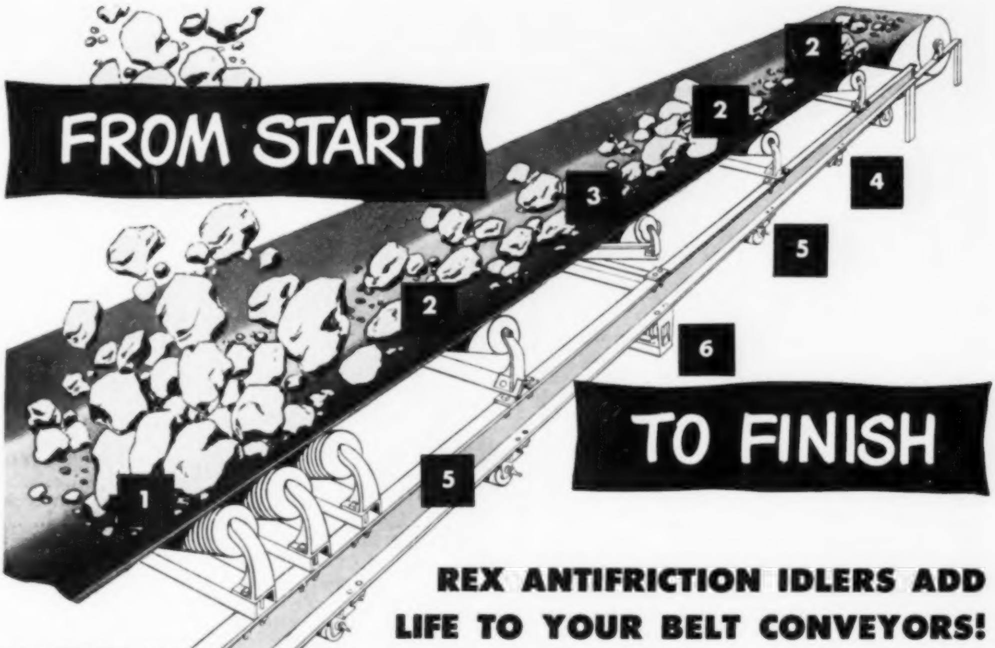

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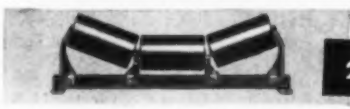
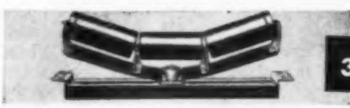
1

REX IMPACT CUSHIONING IDLERS installed under the loading points will take the bumps for your belts . . . minimize ruptures and lacerations. Dual-purpose rubber rolls are scientifically molded with deep primary grooves for maximum cushioning and secondary grooves that provide surface softness to avoid belt laceration.


2

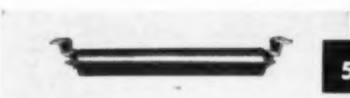
REX TROUGHING IDLERS insure minimum service cost and maximum equipment life. Belt friction wear is practically eliminated, and the closely spaced, well-balanced roll units provide an idler assembly that is kind to the belt. There is a type and style for every application.


3

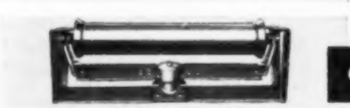
REX SELF-ALIGNING TROUGHING IDLERS automatically align belts without the need for side-guide idlers that impose excessive belt edge wear. They eliminate the misalignments caused by off-center loading, side-wind drifting, warped frames or uneven belt stretch. These idlers fit any belt conveyor frame.


4

REX RUBBER-COVERED SPIRAL RETURN IDLERS create an ever-changing point of contact between belt and idler. Ice, abrasive, corrosive and sticky material cannot build up on the idler and cause premature wear and operating difficulties.


5

REX RETURN IDLERS are dead or live shaft type idlers with hydraulic type fittings for high pressure grease lubrication. They are sturdily built, and their smooth-rolling action cuts belt wear to the minimum.


6

REX SELF-ALIGNING RETURN IDLERS assure automatic belt alignment on the return run. They are similar in general design and effectiveness to the Rex Self-Aligning Troughing Idler.

For complete details on these and the many other idlers in the complete Rex line, write for your copy of Bulletin 463-R. Chain Belt Company, 1648 West Bruce Street, Milwaukee 4, Wisconsin.

CHAIN BELT REX COMPANY — BELT CONVEYOR IDLERS

figures for payout and return on investment often require some revision to keep up with the changing economic picture. It is hoped that the method presented here will be a step in the direction of a more flexible viewpoint in the selection and design of process equipment.

John Happel, New York University, and R. S. Aries, R. S. Aries & Associates, before the Tulsa Regional Meeting, American Institute of Chemical Engineers, Tulsa, May 10, 1949.

NATURAL OILS

. . . *Upgrading*

Conrad J. Gaiser

From a standpoint of both quantity and variety, the most extensive use of chemicals with natural fats and oils is in the synthesis of bodied oils and alkyd resins to develop special properties relative to applications in decoration or protection.

Methods for separating oils from the materials they are naturally associated with have always been devised for most economical use of leftovers rather than best recovery of the oil. There has been a consistant move toward chemical methods of conditioning starting materials. Pressing and solvent extraction are the main systems for recovering oil. At present hexane is the favorite solvent since it is cheap, easily recovered, and doesn't denature meal from an animal utilization standpoint.

Recent information shows consumption of fats and oils in the U. S. is proportioned thus: for food, 68 percent; for soap, 20; for coatings and resins, 8; and miscellaneous, 4. While the edible field uses the lion's share of the fats, it consumes a relatively small amount of chemicals in upgrading. All edibles are reduced to near neutrality by refining and require caustic or soda ash in amounts of 1½ to 2 percent of the oil to neutralize free fatty acids. Most of the oils are produced from the source at about 1 percent free fatty acid content.

Chemicals have their widest application in the drying oil field. The number of products in this field has grown greatly but rate of increase is declining due to wider range of usefulness of each product. We are still a long way from universal vehicles but future formulations will be simpler.

A noteworthy trend: many paint manufacturers are treating oils with their own equipment. This has opened a field for oils which have been given some treatment to enhance

(Continued)

PORTRAIT OF A SUPERSTRUCTURE!

The photograph above shows the first two ports in the melting end of a plate glass furnace after 1290 days and 207,236 tons of glass. (The sidewalls were Corhart Standard blocks — 12″ thick in the lower course, and 8″ thick in the top course.)

But look at that superstructure, built with Corhart Standard Electrocast jambs, plates, crown skew and crown first course. The superstructure took quite a beating in this area, as the 8 remaining inches of the 18″ silica crown plainly shows. Not much is left of the plates, but they did survive the campaign without patching, and the jambs, arches, crown skews and first-course crown blocks are still in excellent shape.

To fortify this area for the next campaign, the operator has installed Corhart Zac refractories in these top course walls and in this entire superstructure area.

If you are not yet making optimum use of Corhart Electrocast products in your superstructure, we would certainly like an opportunity to discuss the potentials with you. . . . Corhart Refractories Co., *Incorporated*, 16th and Lee Streets, Louisville 10, Kentucky.

The words "CORHART," "ELECTROCAST," "ZED," and "ZAC" are Trade Marks which indicate manufacture by Corhart Refractories Company, Incorporated.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

their value to the paint manufacturer. This field offers opportunity to those oil treaters who feel that paint manufacturers are invading their premise, but it is one which demands active and aggressive research. Paint manufacturers are finding that making oils and alkyds in their own plants has disadvantages as well as advantages.

In alkyd resins the use of chemicals reaches the point where chemicals outweight the oils used. Alkyd's most spectacular accomplishment was the replacement of nitrocellulose coatings for automotive and appliance finishes. This was a field of great size and large amounts of alkyds are now made for baking and air drying applications. New materials, however, will certainly serve to keep alkyds keenly competitive with other film formers. Many of the monomers useful in copolymer oils are finding their way into alkyd resins.

Conrad J. Gaiser, before Western Chemical Market Research Group, April 21, 1949.

EDUCATION

. . . *Teaching Science*

Joel H. Hildebrand

There is no good reason for providing one type of introductory science course for the prospective professional scientist and another for the majority who will not major in science. A single course in the freshman year should serve both purposes. The preprofessional chemist, for example, should be introduced to chemistry as a science and not merely to its facts, terminology, and recipes.

There is a profound difference between knowing some elementary facts about a variety of sciences and knowing what science itself is about. It is the difference between the upstart "general education" and the ancient and respectable liberal education. The former is spoken of as if it were merely an improved version of the latter, but as expressed in curricula it is a collection of miscellaneous and necessarily superficial knowledge which can be poured into students, usually within two years.

Liberal education is primarily concerned not with facts but with ideas. The liberally educated person is marked not by what he knows but by how he thinks, and, accordingly, the liberalizing process must involve a generous amount of thinking. It can be begun in college but not completed, in either two or four years.

There is a third approach. It is

(Continued)

based upon two fundamentals of the psychology of learning—first, that it is easier to interest students in the more immediate, live problems than in the more remote, dead ones. The story of a scientific idea is far more exciting if it leads up to the present, into explorations still going on, with unsolved elements inviting immediate hypotheses and possible experiments. Such a story as the discovery and isolation of plutonium has far greater pedagogic value than the story of the development of the air pump.

The second fundamental is that ability to do something difficult is developed not just by hearing it expounded but by first-hand effort and practice. The role of the learner must be an active one. If the goal of understanding science on the part of laymen is to bring a little more reasonableness into human affairs, the most appropriate method is the encouragement of a little scientific thinking and experimentation of the part of students, even if necessarily on a rather elementary plane. Athletes, even amateurs, are developed on the field, not on the bleachers.

Joel H. Hildebrand, University of California, before Maryland Section, American Chemical Society, Baltimore, May 27, 1949.

NUCLEONICS

. . . Four New Reactors

Robert F. Bacher

The real work in the development of nuclear reactors is now gaining headway. This work, which is carried on at many laboratories, is centered in the Argonne National Laboratory near Chicago, the laboratory in which much of the development work leading to the construction of the Hanford piles during the war was done. The development program of the Atomic Energy Commission is built around four major reactors which are now authorized for design and construction. These are a materials-testing reactor, a Navy power reactor, a high-energy breeder, and an intermediate-energy power breeder.

The materials-testing reactor is being constructed in order to study the effects of the intense radiations produced in a nuclear reactor upon the materials used to construct reactors. One of the major difficulties of the past two years has been the serious effects produced upon structural materials by these radiations. This reactor will be able to provide these radiations at an intensity not hitherto available. It should greatly advance

(Continued)

the studies of radiation effects and lead to the development of reactors which operate at higher power.

The Navy reactor is the first attempt to provide a nuclear reactor for a specific power need. This reactor will be a land-based prototype of a unit which we hope will be suitable to drive a ship.

The high-energy or fast-neutron breeder is a machine designed to operate with high-energy neutrons, and thus contains little material which would slow down or moderate the neutrons emitted in the fission process. So far, most of the work on nuclear reactors has been on machines which operate with low-energy neutrons. The main objectives of the fast-neutrons reactor are to explore one of the very interesting possibilities of reactors—the so-called breeding principle—and to produce at least small amounts of electrical power. It looks as if such a machine is possible in principle. Whether or not it will be technically feasible is now being determined. If it proves to be technically feasible, the next step will be to find out whether it is economically feasible.

Another reactor, which is being designed and constructed by the General Electric Co. near Schenectady, is directed toward the production of useful electrical energy and toward the achievement of a machine, operating with neutrons in the intermediate-energy range, which is able to breed new fissionable material. This reactor, as well as the fast reactor, will have energy removed by the circulation of a liquid metal, thus providing heat at a temperature at which conversion to electrical energy can be achieved efficiently.

Robert F. Bacher, commissioner, United States Atomic Energy Commission, before Science Conference, Wellesley College, Wellesley, Mass., March 17, 1949.

SCRUBBING

. . . Venturi Development

W. P. Jones

A new and novel method of wet gas scrubbing, utilizing high gas velocity in the throat of a Venturi tube for collision with and fine atomization of a stationary sheet of scrubbing liquid, has been developed. Scrubbing can be done with water, process liquor, or an absorbing solution. Liquid is injected into the Venturi throat at low pressure and quantities are relatively small. Most of the power required with this scrubber is consumed in ac-

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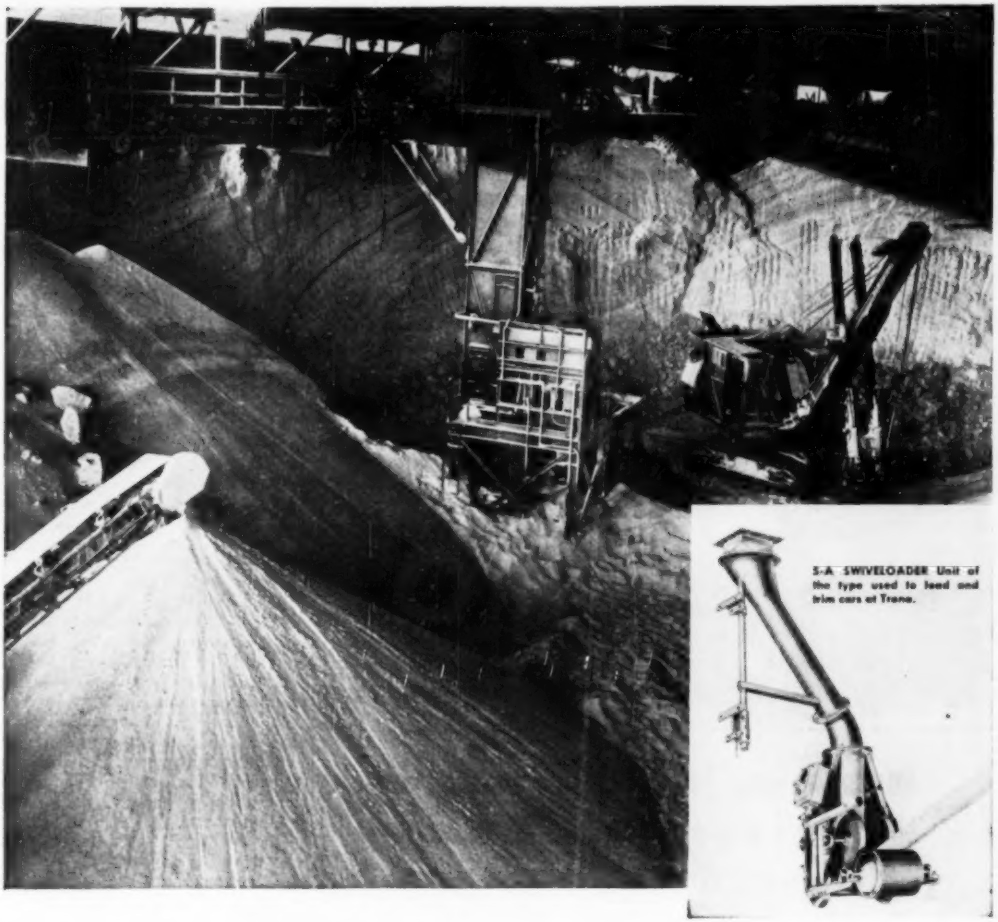

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celeration of scrubbing liquid in the diverging section of Venturi and appears as pressure drop across the Venturi. There are now three large commercial installations in satisfactory operation.

Pilot plant tests during past year show very promising results with high removal efficiencies of sulphuric acid mists and submicron dusts and fumes from gas streams. Further development and test work is being carried out on pilot plant scale as well as on commercial installations.

William P. Jones, Chemical Construction Corp., before Division of Industrial and Engineering Chemistry, American Chemical Society, San Francisco, March 29, 1949.

PETROLEUM

. . . Free Market

Marion E. Dice

The petroleum industry was faced with a 50 percent increase in population and an 81 percent increase in over-all demand for liquid petroleum products between 1939 and 1948.

It is no wonder that in the face of these demands a few people underestimated the resourcefulness of the petroleum industry and raised their voices in fear of an oil shortage.

Fortunately the powerful corrective forces of a free market were already at work, and before the planners and controllers could get their blue prints ready for the new Congress, the supply situation changed from scarcity to surplus. The solution came faster than the planners could plan.

The present petroleum situation in the West as one of unbalanced product yields. Refiners are operating their plants for maximum gasoline yields to keep up with the huge anticipated summer gasoline demand. In doing so, they are unavoidably making more fuel oil than can currently be sold.

The problem has been complicated by an over-all shift in the proportion of liquid fuels consumed with fuel oil's share of the total lagging behind those of gasoline and diesel oil in the last 10 years.

As a consequence, last year the various companies in California put 16 million barrels of heavy fuel oil into storage. This meant freezing about $32 million of working capital until the oil can be sold or used. It represents a sizable portion of last year's profits. An income tax was paid on it, even though frozen inventories do not generate any cash to pay the tax.

The problem is not yet critical, and several alternatives are available

(Continued)

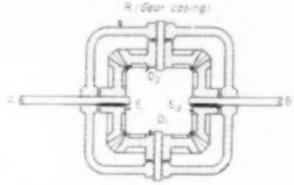
to correct the surplus. Among them are the building of more plants for further processing of the unsold material. Producing less heavy crude oil is another possible solution.

Marion E. Dice, General Petroleum Corp., before Chamber of Commerce, Long Beach, Calif., April 27, 1949. —*End*

FOREIGN LITERATURE ABSTRACTS

Mechanical Nomograph

The principle of differential gearing as used in automobiles has been applied to the design of a mechanical nomograph on which the scales move and the cursor remains stationary. The principle of the differential, essentially the same as that for an orthodox nomograph, is outlined in terms of this sketch:



The sum of the movements of A and B is always twice the movement of the gear case R. In equation form, $R = (A + B)/2$. In the orthodox nomograph:

the relation between R, A, and B is expressed $R = (M_2A + M_1B)/(M_1 + M_2)$ where M_1 and M_2 are separations of the R scale from the A and B scales respectively.

The differential is a mechanical analogue of an orthodox nomograph on which $M_1 = M_2$. The mechanical nomograph can be calibrated according to the type of equation to be solved. With scales on a circular drum considerable scale length can be accommodated on the machine without resorting to excessively large equipment.

For a nomograph of this type there is an advantage in choosing the scale range of one unit of logarithms where possible so any overlapping values can be found on the other end of the scale by proper shifting of the decimal place. The equation, $y = 52.46x/z$, frequently used in the gas industry, will serve as an example of the practical application of the machine. Here y = grains NH_3 per 100 cu. ft., x = ml. 2N H_2SO_4, and z = cu. ft. gas passed. The following ranges could have been chosen: z, 4 to 40 cu. ft., and x, 1 to 100 ml. (By shifting the decimal place z also covers the ranges 0.4 to 4 and 40 to 400.)

While the cost of making such a machine would be quite high, its usefulness where many routine calculations are carried out would be considerable. Where one operator must both carry out the tests and calculate the results worm gears can be used to turn the scales, so that one scale will be fixed in the position of the first variable and the operator can set the other scale by hand.

Digest from "Three-Line Mechanical Nomograph" by W. A. Spark, *Australian Chemical Institute Journal & Proceedings*, 16, No. 3, 91-94, 1949. (Published in Australia.)

Ignition of Vanadium Sulphate Catalysts

Industrial value of contact masses used for exothermic reactions is determined by their activity, stability and ignition temperature, which is the minimum temperature at which the incoming gas will assure quick heating to optimum conditions for the process. The ignition temperature depends on the nature of the catalyst, composition of the reaction mixture, exothermic nature of the reaction and also on the temperature increase required during a given time of contact with the catalyst. A thermographic method was developed for determining the ignition temperatures of vanadium sulphate catalysts for gaseous mixtures containing from 7 to 95 percent sulphur dioxide and from 5 to 75 percent oxygen.

With a constant oxygen concentration the ignition temperature is practically independent of the sulphur dioxide concentration; it drops with increase in the oxygen concentration. The ignition temperature is 423 deg. for gas obtained by roasting pyrites and containing 7 percent sulphur dioxide and 11 percent oxygen. It is 394 deg. for a stoichiometric mixture (66.7 percent SO_2, 33.3 percent O_2). Concentrated mixtures of sulphur dioxide can therefore be treated with oxygen without any difficulty in regard to increase in ignition temperature if the oxygen concentration is sufficiently high (not less than 10 percent). The

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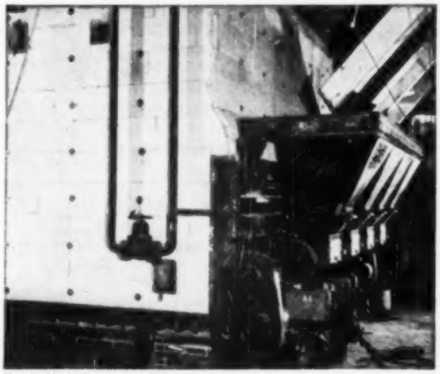
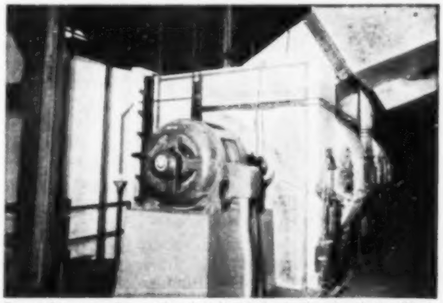


Kaylo Heat Insulating Block covers boiler



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Handles wide temperature range . . . has low thermal conductivity! Kaylo Heat Insulating Block is ideal for jobs involving temperatures from 200° to 1200° F. It maintains its thermal stability, isn't affected after exposure and service. Then, too, due to its very fine cellular structure, its conductivity remains low at top operating temperatures, making it one of the most efficient and economical insulating materials.

Has low density . . . high compressive strength! Kaylo Heat Insulating Block's low density simplifies handling, shipping and application. It weighs only 11 pounds per cubic foot—less than one pound to the board foot. Yet, Kaylo Heat Insulating Block has an unusually high compressive strength for a mineral product of such a light weight.

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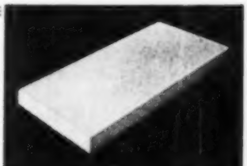
	Locomotives



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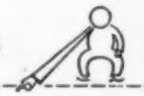

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ignition temperature increases with reduction in the activity of vanadium catalysts due to thermic treatment or prolonged use, and this increase is directly proportional to the logarithm of the ratio of the initial and final values of the constant of the rate of reaction.

Digest from "Ignition Temperature of Vanadium Sulphate Catalysts" by G. K. Boreskov, L. G. Ritter and E. I. Volkova, *Zhurnal Pinkladnoi Khimii* XXII, No. 3, 250-260, 1949. (Published in Russia.)

The Chemical Industry Of Italy

The Italian chemical industry grew up later than in the other leading countries, and was long in a position of definite inferiority.

Some were of the opinion that this inferiority was inevitable because of the industrial structure of Italy and the shortage or lack of some essential raw materials.

But this is not really the case because Italy possesses large supplies of two of the main groups of key raw materials consisting of sulphur and sulphur metallic ores and the group of brines and rock salt. Intensive farming practiced in many parts of Italy, and the growth of some of the manufacturing industries, above all of the textile industries, favor the growth of an Italian chemical industry.

All these factors, and the opportunities offered by some great plants opened for making munitions of war, contributed after the first world war to start the Italian chemical trades towards a rapid rise, as the result of which they were able on the eve of the last world war to compete in many fields with their more important foreign competitors.

In 1938, a year of record production, the following quantities were turned out in the several branches of the trade: sulphuric acid (50 Bé) 1,871,268 m. tons; caustic soda, 165,019 tons; carbonate of soda, 352,010 tons; hydrochloric acid, 54,785 tons; ammonia, 113,201 tons; calcium carbide, 134,862 tons; coke, 2,609,254 tons; organic dyestuffs, 10,678 tons of which 18 percent were vat dyes, naphthols, bases, etc.

Italy had become a large exporter of all these products, with the exception, of course, of coke.

Progress was not brought to a standstill in 1938; indeed, in the following war years some of the products connected for instance with the output of synthetic ammonia and nitrogenous products, the distillation of coal, aluminum metals, etc., enlarged and im-

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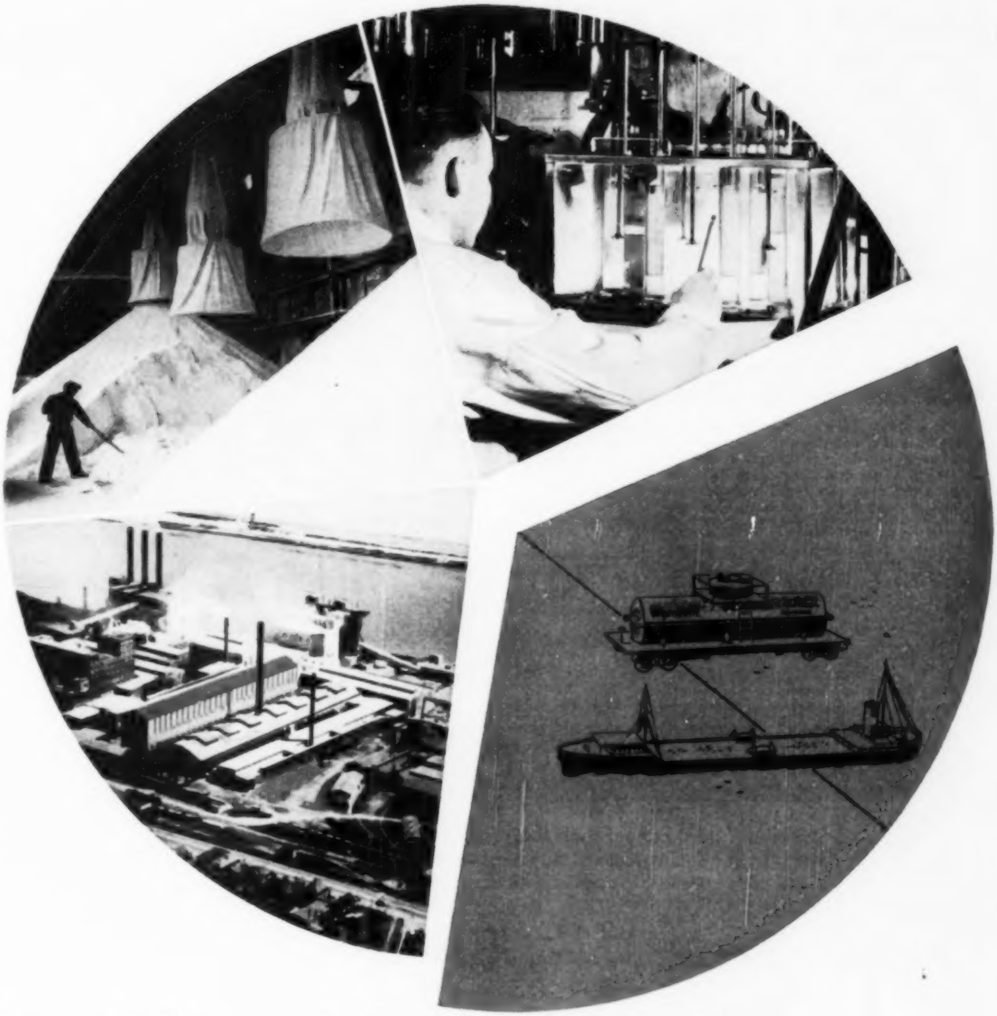

Economical transportation completes the picture

As a user of basic chemicals, it will pay you to consider these facts:

Wyandotte is located at the heart of the Great Lakes waterways. Company-owned sources of raw materials — coal, limestone and salt — are close at hand. Recently expanded plant facilities, plus diligent research and 59 years' experience in the field, all assure you of a steady, dependable supply of chemicals — today and tomorrow.

Because of its location, Wyandotte can ship to you either by rail or by water. This company is in a unique position to send caustic soda, soda ash and other chemicals via *both* these forms of transportation.

Wyandotte will be glad to consult with you on your requirements. For *complete* service in chemicals, get in touch with your nearest Wyandotte Representative.

Wyandotte Chemicals Corporation

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CALCIUM CARBONATE • CALCIUM CHLORIDE
CHLORINE • HYDROGEN • DRY ICE
GLYCOLS • SYNTHETIC DETERGENTS
CARBOSE (Sodium CMC) • ETHYLENE DICHLORIDE
PROPYLENE DICHLORIDE
AROMATIC SULFONIC ACID DERIVATIVES
OTHER ORGANIC AND INORGANIC CHEMICALS

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proved their plants in a marked degree.

In 1945 an immense effort for reconstruction started. The chemical trades gave evidence of their vitality by undertaking, without government help, the reconstruction of their plants. This work may now be considered completed and last December output amounted to 87.2 percent of the prewar figure, and gave work to some 140,000 persons. In that year the total exports of chemicals exceeded the prewar volume and represented a total value of 29 billion lire (about $50 million) being 5.3 percent of all Italian exports.

THE PRESENT SITUATION

For nearly seven years the Italian chemical trades were carried on under cover. They could not enjoy the advantages of free contacts with the outside world, of the constant exchange of ideas, information, patents and systems of production. At the same time they had to exploit to the utmost their output potential without being able to provide in due time for bringing the plants up-to-date.

Since 1945 much has been done to modernize the plants and at the present time the potential of the Italian chemical industry may be considered sufficient to meet the demand on the domestic market. Nevertheless plans are being made for erecting other plants in connection with the ERP 4 year plan. Among these special mention should be made of the new factories for producing synthetic ammonia and nitrogenous fertilizers, and of those for refining crude mineral oils. In the case of nitrogenous products, the present output capacity of nitrogen will be about 175,000 tons at the end of the current year and should exceed 210,000 at the end of 1950.

The Italian four-year plan provides for a large development of exports of chemicals on European markets.

Generally speaking, the Italian industry will be able to assert itself on international markets whenever it can enjoy the following essential conditions: (1) the possibility of processing Italian raw materials; (2) the possibility of processing foreign raw materials by the use of large quantities of reagents produced by the home industry, which represent a heavy percentage of the processing costs; (3) the possibility of processing foreign raw materials when the geographical location of the plants can be taken advantage of.

Digest of a report drawn up by Eng. Morandi, general manager of the Montecatini, for the Chemical Society of Milan.

—*End*

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Left: These neat-appearing, insulated tanks are weather-protected by the Johns-Manville specification described here.

Below: Applying J-M Asbestocite (asbestos and cement sheets that are weather- and corrosion-resistant) over standard J-M Insulations.

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If you have outdoor tanks and vessels... and are heating or cooling them it will pay you to look into the Johns-Manville Weather-Protected Insulation specification.

Weather-Protected Insulation pays even though outdoor storage tanks are operated at moderate temperatures—because wind and other weather conditions can greatly affect tank temperatures. Savings, for example, on a standard fuel storage tank operating at 130 F maintained temperature can be as much as 200 Btu/sq. ft./hr.

Basically, this Johns-Manville Weather-Protected Insulation specification consists of standard J-M insulations over which is applied Johns-Manville Asbestocite (asbestos-cement sheet) to protect the insulation from the weather. Shielded in this manner, the insulation pays dividends in fuel savings for many years.

If you wish, a Johns-Manville Insulation Engineer will be glad to survey your outdoor equipment to estimate fuel savings for you. Or, for more details send for a copy of folder IN-121A. Johns-Manville, Box 290, New York 16, New York.

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Chemical Engineer's Bookshelf

LESTER B. POPE, Assistant Editor

Legal Lore

TRADE-MARKS. By H. Bennett. Chemical Publishing Co., Brooklyn. 479 pages. $10.

Reviewed by Joseph V. Meigs

This book occupies 479 pages of text divided into three principal topics (1) Legal Aspects, (2) Coining of Trade-Marks and (3) Trade-Mark Dictionaries.

About 42 percent of the text is devoted to the topic entitled "Legal Aspects." Most of this is occupied with reproductions of the trade-mark statutes and rules of practice of the United States and foreign countries. Those who do not have readily-available such statutes and rules of practice may find it convenient to refer to them in the author's book.

The second principal topic deals with the coining of trade-marks. The coining of a mark always presents a problem and what the author has to say will no doubt prove helpful. On p. 203 the following statement is found:

"A surname used as a trade-mark lends a degree of stability or character. It is distinctive and shows pride of ownership and gives the assurance that the firm will strive to give the best in quality and service."

That advice is open to considerable doubt. See for example, the recent decision of the Circuit Court of Appeals for the Second Circuit in the case of S. C. Johnson & Son, Inc., v. Johnson, decided June 2, 1949. In that case the well-known maker of waxes, etc. brought suit against Johnson Products Co. Defendant sold cleaning fluid (not waxes) and confusion resulted because of the identity of the name Johnson in the mark on plaintiff's and defendant's products. The plaintiff was defeated apparently on the theory that because defendant was using his own name no intent could be shown to misappropriate the plaintiff's good will.

The disadvantage of using a surname and the advantage of using a fabricated or coined trade-mark is evident from the following quotation from the Court's decision. See 81 United States Patent Quarterly, 513:

"If Congress really meant to allow every first user of a mark so to stifle all excursions into adjacent markets upon showing no more than that confusion would result, it seems to us that it would have said so more clearly. In the case of fabricated marks which have no significance, save as they denote a single source or origin of the goods to which they are attached, the first user's right may indeed go so far. The second user can then show no interest of his own; and if, as will then appear, his only purpose is to trade on the first user's good will, it is indeed time to intervene. That situation is polar to this, and we do not believe that both have been swept into a common condemnation by the language used to create the new federal right."

The third part of the book which occupies about 52 percent thereof, deals with trade-mark dictionaries in which numerous trade-marks are classified under various headings.

In summary, it is thought that the book should be a useful adjunct to the libraries of those who are interested in the subject.

Exceptional

SURFACE-ACTIVE AGENTS; Their Chemistry and Technology. By A. M. Schwartz and J. M. Perry. Interscience Publishers, New York. 579 pages. $10.

Reviewed by Robert S. Aries

This book is an exception to the heretofore bountiful rehashed works on the subject of surface-active agents. It summarizes systematically the achievements of the last three decades in developing a host of new products in the field. Laboratory synthesis, commercial production and uses are ably grouped in a novel system, according to the nature of the solubilizing group and the way it is joined.

The discussion of the physico-chemical aspects of surface-active agents adds to the comprehensiveness and broad background of the book, even though most of the material could be found elsewhere.

The main contribution of the book is in giving us the processes for synthesizing and manufacturing which refers to over 1,500 patents, as well as the practical applications of surface-active agents. Evaluation of detergency is adequately discussed.

The book is well indexed and should be a valuable addition to the library of every technical man and company interested in surface-active agents.

New Goals

ENGINEERING THE NEW AGE. By John J. O'Neill. Ives Washburn, New York. 320 pages. $3.50.

Reviewed by H. C. Parmelee

In the opinion of the author, the tide in human affairs is presently at low ebb and a new era is unfolding in which all of our resources will be directed toward human welfare. The forces behind this era are the spirit of science and the techniques of engineering which, however, are henceforth to be motivated by a consciencenes of social obligation. The pattern for this development is found in nature, which works with a degree of cooperation and coordination, purpose and efficiency notably lacking thus far in the otherwise remarkable achievements of mankind.

The author is by no means the first to recognize the need, and urge the acceptance, of social consciousness by scientists and engineers. But he goes farther than others in implementing his idea with a pattern for development. Of necessity the concept envisages broad horizons and great possibilities, in sharp contrast with the defeatist doctrine that our civilization has matured, that opportunity has diminished to the vanishing point, and that security is now the prize to be sought.

By way of stimulating the imagina-

(*Continued*)

RECENT BOOKS RECEIVED

Constructive Uses of Atomic Energy. By S. C. Rothman. Harper. $3.

Conveyors and Related Equipment. 2nd ed. By W. G. Hudson. Wiley. $7.

Electronic Interpretations of Organic Chemistry. 2nd ed. By A. E. Remick. Wiley. $6.

Industrial Rheology and Rheological Structures. By H. Green. Wiley. $5.50.

Introduction to Radiochemistry. By G. Friedlander & J. W. Kennedy. Wiley. $5.

Ion Exchange, Theory and Application. Ed. by F. C. Nachod. Academic Press. $8.50.

Maintenance Manual of Electronic Control. By R. E. Miller. McGraw-Hill. $4.50.

Personnel Selection Test and Measurement Techniques. By R. L. Thorndike. Wiley. $4.

Physics and Chemistry of Cellulose Fibres. By P. H. Hermans. Elsevier. $9.50.

Tin—Its Mining, Production, Technology and Applications. 2nd ed. By C. L. Mantell. Reinhold. $10.

tion and orienting us to the magnitude of the job to be done in engineering the new age, the author makes a brief survey of the cosmos and its magnificent design. "In the heavens we find an engineering job whose grandeur staggers our ability to comprehend." But it offers a pattern to be followed in the finite job of making a better world, which man has been struggling to do in a haphazard manner and with a limited amount of available energy. In the atomic age, however, our energy wealth will be fabulously greater than that of our present era, with equally increased potentiality of accomplishment for human welfare.

The groundwork has been laid in the engineering achievements of the past and the development of engineering techniques adapted from nature, the master architect. The development of the future rests with wise cooperation among scientists, engineers, social and political planners, and business executives "to give form and design to human hopes and happiness, to a design for life." If it is up to scientists and engineers to acquire a social consciousness, it is equally incumbent on sociologists, politicians, and business executives to gain an appreciation of the engineering approach and realize that it is applicable to all kinds of human problems.

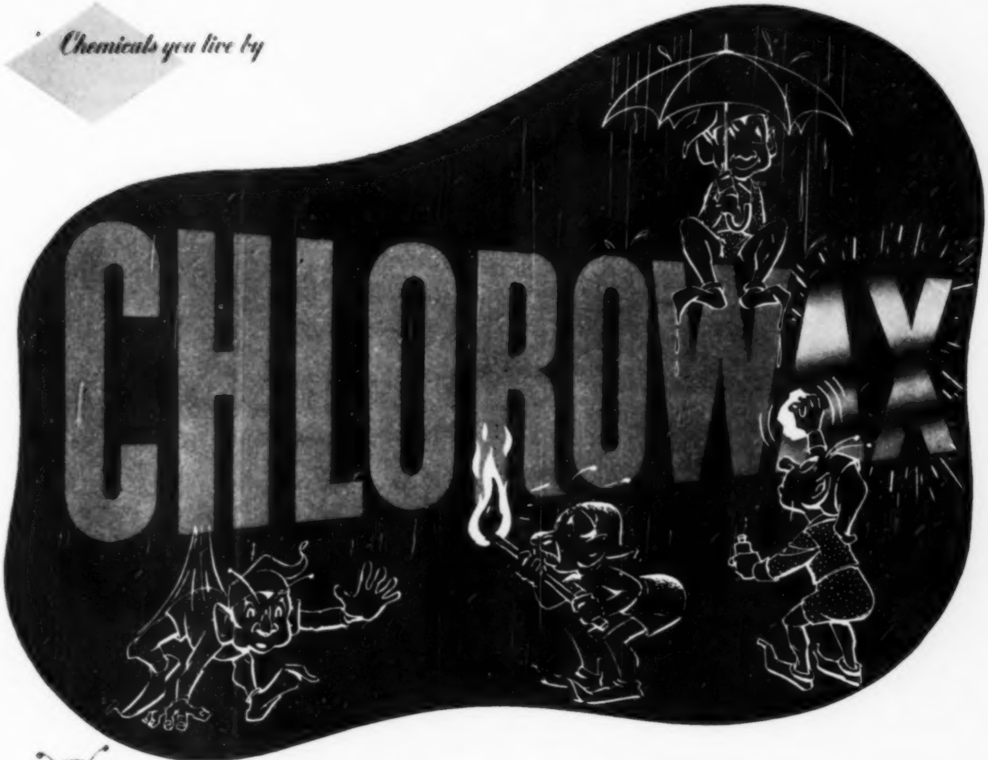
Considering the importance of the city in human affairs, it is not surprising that Mr. O'Neill devotes several chapters to its failure to serve its purpose. He finds it afflicted with "urban ulcers" that call for major operations in new design and location. Present cities with their skyscrapers are monuments to chaos, built without regard to their functions. Highways and railroads also come under condemnation as inadequate means of communication and transportation. Remedies for these evils lie in engineering with a social consciousness.

Expansion of our energy sources should be the first item in any program for planning for the future. Quite obviously this should be done through the development of atomic energy projects. The author considers uranium and thorium processes, and recommends the latter on several grounds: cost of raw material, safety of the operation, and location of plants near points of consumption.

New goals in the education and organization of engineers will have to be set up if they are to meet the hopes and expectations of Mr. O'Neill, chief among which must be the assumption of larger social responsibilities and the achievement of a world-wide viewpoint.

(Continued)

Chemicals you live by



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CHLOROWAX 70 is a chlorinated paraffin containing 70% chlorine by weight. It is a powdered solid—definitely resinous—not a wax. It is chemically inert, odorless, non-toxic, nonflammable, insoluble in water, yet soluble in a wide variety of solvents.

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Specific Gravity—Solid	1.62-1.70
Molecular weight	approx. 1060
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BOOKS, cont. . .

Recent Metallurgical Books Briefly Noted

INDENTATION HARDNESS TESTING. By Vincent E. Lysaght. Reinhold Publishing Corp., New York. 287 pages. $5.50.

The author discusses both hardness concepts and hardness tests. He relates primarily to indentation hardness of different metallic surfaces under hot and cold conditions.

ENGINEERING METALS AND THEIR ALLOYS. By Carl H. Samans. The Macmillan Co., New York. 913 pages. $7.50.

This book could be said to be a complete course in metallic materials and processes. Included within its covers are production methods, treatments, properties and uses of pure metals and alloys.

PREVENTION OF IRON AND STEEL CORROSION. By C. Dinsdale. Louis Cassier Co., Ltd. Distributed by Iliffe & Sons, Ltd., London. 88 pages.

Dinsdale presents a series of comprehensive tables on protective coating materials for iron and steel surfaces. This handbook also lists methods of application, processes for cleaning metal parts, and standard packaging specifications.

THEORETICAL STRUCTURAL METALLURGY. By A. H. Cottrell. Longmans, Green & Co. Inc., New York. 256 pages. $5.25.

In text form, this book describes the theories of interatomic and electron activities contingent with the processing of metals and alloys. It is complete with their applications to property changes of the metals treated.

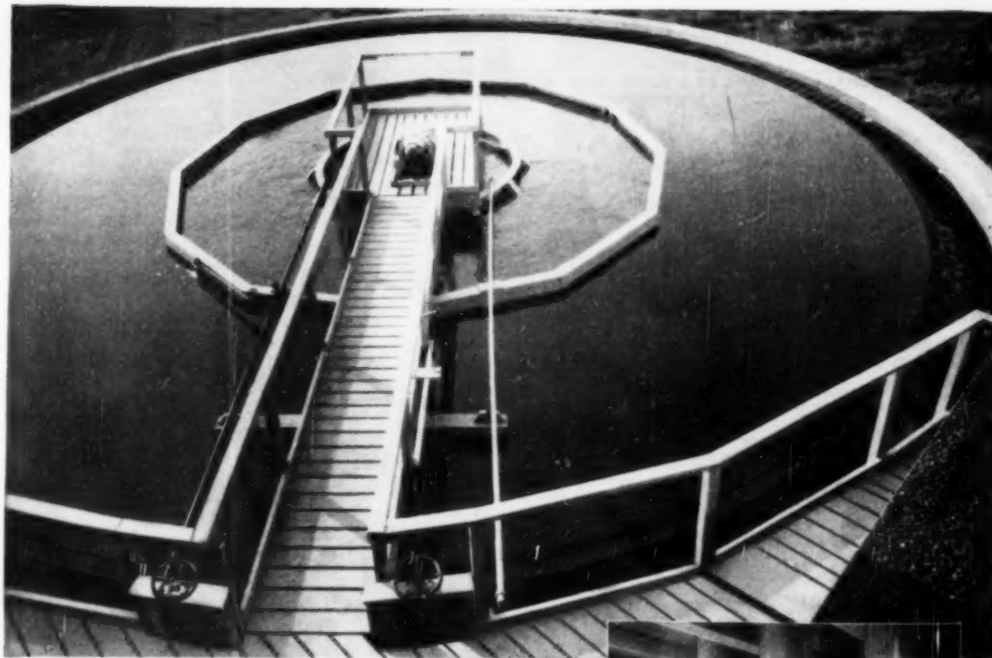
COPPER AS AN ALLOYING ELEMENT IN STEEL AND CAST IRON. By C. H. Lorig and R. H. Adams. McGraw-Hill Book Co., New York. 213 pages. $3.

What effects does copper, as an alloying element, have on the properties of steel and cast iron? The authors answer just that question. The book includes complete mechanical properties tables and heat treating charts.

MOLYBDENUM. By R. S. Archer, J. Z. Briggs, and C. M. Loeb Jr. Climax Molybdenum Co., New York. 391 pages.

Molybdenum is a great alloy element primarily known for the increased hardenability it produces in steels. Here is a thorough report on

(Continued)



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Bring BIG Savings to Baldwin Locomotive Works

BALDWIN *saved substantial sums* by selecting ACCELATORS for their water treatment problems! Savings were made not only on installed costs, but are being realized from day to day in maintenance, too. Better still, ACCELATORS are giving Baldwin *a finer quality water than they ever thought possible*, at a much lower cost than that formerly paid for city water. It is serving for process, cooling, high pressure boiler feed, and uses not originally contemplated.

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Books, cont. . .

molybdenum as an alloying element and the properties it imparts.

Modern Metallurgy of Alloys. By R. H. Harrington. John Wiley & Sons, New York. 209 pages. $3.50.

Written primarily for industrial research "works" laboratories and metallurgists in general, this book emphasizes the "whys" of alloy properties. It correlates modern theory with practical data.

Modern Metallurgy for Engineers. By Frank T. Sisco. Pitman Publishing Corp., New York. 500 pages. $5.

Here is a comprehensive text covering virtually all phases of metallurgy. It includes extensive treatment of engineering processes and treatment on their properties.

Principles of Metallographic Laboratory Practice. Third Edition. By George H. Kehl. McGraw-Hill Book Co., New York. 520 pages. $5.50.

Here is a complete course in metallurgical laboratory technique and analysis. Kehl treats preparation of specimens, microscopy, etching, testing, and thermal analysis.—*RWT*

Recent Books & Pamphlets

Consulting Services. Twelfth Edition. Published by the Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st St., New York 17, N. Y. 132 pages. Lists firms of chemical consultants along with description of their facilities and specialties and the names of their executives. Indexed by name and by field.

The Future of Business Research. Published as a report of 1949 Economic Institute by Chamber of Commerce of the United States, Washington 6, D. C. 110 pages. $1. Addresses made by six industrial executives leading a discussion of the Institute in Chicago, February 1949. Presents many features of importance in management planning of general business statistics and market research, but principally non-technical features.

Telling the Story of Engineering Research. Engineering College Research Council, State University of Iowa, Iowa City, Iowa. 52 pages. 50 cents. Contains the text of seven addresses given before the winter meeting of the council. The speakers, each connected with a different form of communications, discuss methods of publicizing engineering research in their respective media.

Acids, Bases and Non-Aqueous Systems. By Ludwig F. Audrieth. Published by Phi Lambda Upsilon, Department of Chemistry, The Pennsylvania State College, State College, Pa. 66 pages. $2. Twenty-Third Annual Priestley Lecture. Contains chapters on historical development and modern concepts of the acid-base relationships, the nitrogen system of compounds, the hydronitrogens and acid-base relationships in high temperature systems.

Forests! Bogalusa's Past—Present—Future. Published by Gaylord Container Corp., Bogalusa, La. 12 pages. A supplement to the March 29 issue of the "Bogalusa Daily News." Reviews pictorially the development of the pulp and paper industry in the Bogalusa area.

—*End*

3

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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittance should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Alcohol From Agricultural Sources as a Potential Motor Fuel. By G. E. Hilbert, Chief, Bureau of Agricultural and Industrial Chemistry, Department of Agriculture, AIC-233. Mimeographed. Discusses possibility of converting surplus agricultural products into motor fuels.

Soaps and Synthetic Detergents for Home Laundering of Cottons. By Margaret S. Furry, Bureau of Human Nutrition and Home Economics, Department of Agriculture. Mimeographed.

Publications and Patents of the Eastern Regional Research Laboratory. 1939—December 1948. Bureau of Agricultural and Industrial Chemistry, Department of Agriculture, AIC-180, including Supplements 1 and 2. Mimeographed.

Price Programs of the U. S. Department of Agriculture, 1949. Compiled by H. W. Henderson. Department of Agriculture, Miscellaneous Publication 683. Price 15 cents.

Farm Production, Farm Disposition, and Value of Principal Crops, 1947-1948, by States. Bureau of Agricultural Economics, Department of Agriculture, May 1949. Mimeographed.

Development of Insect Resistance to Insecticides. By Frank H. Babers, Bureau of Entomology and Plant Quarantine, Department of Agriculture, E-776. Mimeographed. Reviews development of resistance to insecticides by the several insects to determine whether sufficient evidence has been presented to warrant a theory as to cause of resistance.

The Mode of Action of Organic Insecticides. By Robert L. Metcalf. Chemical-Biological Coordination Center, Review No. 1. National Research Council. Price $1. Order from Publications Office, National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C. Contains nine chapters, each dealing with a recognized insecticide or class of insecticides.

Tables of Sines and Cosines to Fifteen Decimal Places at Hundredths of a Degree. National Bureau of Standards, Publication AMS 5. Price 40 cents.

Water Levels and Artesian Pressure in Observation Wells in the United States in 1945; Part 2: Southeastern States. Geological Survey Water-Supply Paper 1024. Price 50 cents.

Surface Water Supply of the United States in 1946; Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basin. Geological Survey Water-Supply Paper 1062. Price 75 cents.

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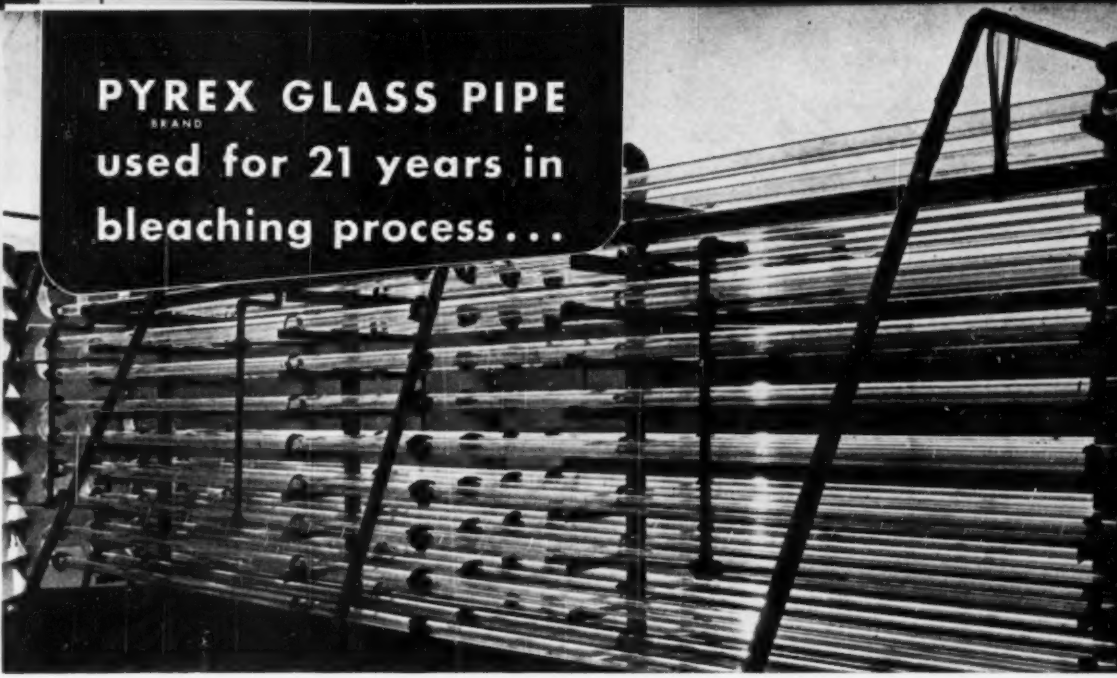
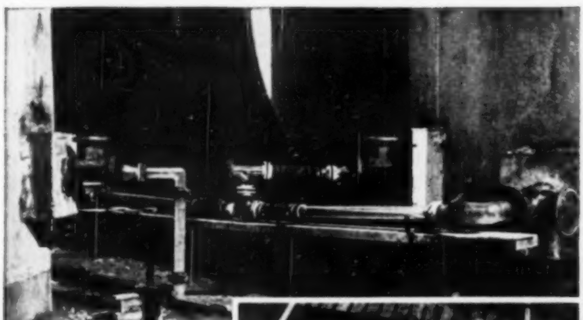
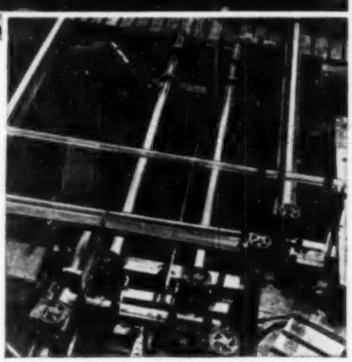
used for 21 years in bleaching process...







Top Photograph—
Section of PYREX brand Glass Pipe heat exchanger atop plant of Kuehne Chemical Co., Elizabeth, N. J.

Lower Photographs—
Some of the 3,000 ft. of PYREX pipe in use for transferring highly corrosive bleach.

Over 3,000 ft. used for cooling and transferring products...stops corrosion discoloration, metallic contamination.

Ever since 1928, Kuehne Chemical Co., Elizabeth, N. J., has been using PYREX brand glass pipe for the manufacture of bleach used in bleaching textiles, shellacs, dyestuffs and in dilute form, for household purposes. Few, if any services, involve any sterner test of corrosion resistance!

As the result of its satisfactory performance, more than 3,000 ft. of PYREX brand glass pipe are now in use at this plant, about half of it outside where it is exposed to all weather conditions. In fact, bleach is pumped to the PYREX heat exchanger on top of the plant where it is sprayed with cold water. Only the great resistance of PYREX pipe to thermal and physical shock makes this possible.

According to Mr. R. W. Lillie, Plant Manager, "Maintenance costs are very low. Replacements are infrequent, mostly limited to gaskets, but we do keep spare pipe on hand for any emergency."

It will pay *you* to check into the practical operating economy of using PYREX brand glass pipe. Ask for a copy of Bulletin EA-1 which highlights how many important chemical and food processors use PYREX brand glass to improve products and cut costs.

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GOVT. PUBS., *cont.* .

Quantitative Study of Variations in Concentration of Glycerol and Aerosol OT on Foaming Volume of Oil at Room Temperature. By J. W. McBain and Sydney Ross. National Advisory Committee for Aeronautics, Washington, D. C. Technical Note No. 1841. A study of foam inhibiting action and froth volume and air entrainment.

Large Rivers of the United States. Geological Survey Circular 44. Mimeographed.

Interpreting Ground Conditions from Geologic Maps. Geological Survey Circular 46. Mimeographed.

Electrolytic Manganese in Acid Electric Steel Foundry Practice. By F. Sillers, Jr. Bureau of Mines, Report of Investigations R. I. 4482. Mimeographed.

Coproducts of Coke in the United States, 1919-1947. By J. A. DeCarlo and J. A. Corgan. Bureau of Mines, Information Circular I. C. 7504. Mimeographed.

Some Chemicals from Synthetic Liquid Fuels Processes. By N. Golumbic. Bureau of Mines, Report of Investigations R. I. 4467. Mimeographed.

Explosive Properties of Hydrazine. By F. E. Scott et al. Bureau of Mines, Report of Investigations R. I. 4460. Mimeographed.

Lime-Soda Sinter Process for Alumina from High-Silica Bauxites: Laboratory and Pilot-Plant Tests. By J. E. Conley and M. L. Skow. Bureau of Mines, Report of Investigations R. I. 4462. Mimeographed.

Investigation of Concentration Sections at the Central Mill of the Eagle-Picher Mining & Smelting Company, Cardin, Oklahoma. By H. Kenworthy et al. Bureau of Mines, Report of Investigations R. I. 4511. Mimeographed. Includes separation of special compounds by ore dressing methods.

Mining Methods and Practices at International Minerals & Chemical Corp., Potash Mine, Eddy County, N. Mex. By G. T. Harley and W. R. Storms. Bureau of Mines, Information Circular I. C. 7511. Mimeographed.

Small Portable Coal-Dust Explosion Gallery. By G. W. Grove and G. L. Freas. Bureau of Mines, Information Circular I. C. 7520. Mimeographed.

Titanium. Report of Symposium on Titanium, sponsored by Office of Naval Research, 16 December 1948. Department of the Navy. Price 65 cents. Complete record of formal talks presented at meeting, to provide a comprehensive review of the titanium research effort and progress thus far attained.

Purchased Items and Purchasing Locations of the Department of the Army. By Current Procurement Branch, Logistics Division, General Staff, U. S. Army, July 1949. Mimeographed. Obtain from Procurement Information Center, The Pentagon, Washington 25, D. C. A pamphlet designed to assist small business.

Commodity Code Book. Economic Cooperation Administration. Mimeographed. Obtain from Economic Cooperation Administration, Office of Information, 800 Connecticut Ave., Room 415, Washington 25, D. C. Contains groups into which all food, agricultural and industrial commodities, as well as services and transportation costs, may be classified, together with ECA numbers which identify each group. Supersedes September 10, 1948 Edition.

Refuse Collection and Disposal. Compiled by Leo Weaver. Federal Security Agency. Available from Surgeon General, Public Health Service, Attention: Division of Sanitation, Washington 25, D. C. Mimeographed. A bibliography of the literature from 1940 to 1948 which will permit review of scientific material and practical operating methods from which new company's plans can well start.

Report on Review of Allocations of Costs of the Multiple-Purpose Water Control System in the Tennessee River Basin, as Determined by the Tennessee Valley Authority and Approved by the President under the Provisions of the TVA Act of 1933, as amended. Federal Power Commission, March 23, 1949. Washington, D. C. Mimeographed.

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MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Compressors. Clark Bros. Co., Inc., Olean, N. Y.—Two 8-page booklets on compressors made by this company. One is on axial flow compressors and the other on multi-stage centrifugal compressors.

Lubrication Equipment. Farval Corp., 3293 East 80th St., Cleveland 4, Ohio.—8-page pamphlet describes this company's centralized systems of lubrication. Takes up its use in six different industries.

Wire Cloth. Michigan Wire Cloth Co., 2100 Howard St., Detroit 16, Mich.—Two kits contain samples of this company's wire cloth and metal filter cloth. The kits are in pocket-sized book form.

Gloved Boxes. Radioisotope Applications Co., 1834 University Ave., Berkeley 3, Calif.—8-page booklet describes and illustrates the glassed in boxes made by this company for working on radioactive isotopes. Port holes with gloves mounted in them allow work to be done in the boxes without contamination.

Scales. Toledo Scale Co., P. O. Box 97, West Toledo Station, Toledo 12, Ohio.—8-page folder entitled "Better Ways" covers this company's line of scales for industrial weighing.

Expansion Joints. Chicago Metal Hose Corp., Maywood, Ill.—8-page Bulletin EJ-49 gives engineering and product information concerning piping where pressure and temperature extremes exist.

Water Conditioners. Bird-Archer Co., 400 Madison Ave., New York.—4-page leaflet describing this company's use of amine treatment to inhibit corrosion of boiler and condensate systems.

Electrical Specialties. Miskella Infra-Red Co., East 73rd and Grand Ave., Cleveland 4, Ohio.—2-page flyer covers this company's line of infra-red lampless heating units.

Water Conditioning. Dorr Co., 570 Lexington Ave., New York 22, N. Y.—8-page Bulletin No. 9141 describes construction and use of equipment for treatment of water for removal of turbidity, color or hardness prior to filtration.

Photographic Equipment. Eastman Kodak Co., Industrial Photographic Division, 343 State St., Rochester 4, N. Y.—12-page pamphlet describes four models of micro-file machines. Also deals with micro-file readers, enlargers and projectors.

Instruments. The Esterline-Angus Co., Inc., Box 596, Indianapolis 6, Ind.—8-page Bulletin No. 549 details the working and applications of the DC milliameter for recording small electrical quantities.

Wire Cloth. Ludlow-Saylor Wire Co., 634 South Newstead Ave., St. Louis 10, Mo.—80-page Catalog No. 90 list dimensions, prices and properties of their line of industrial wire cloth and woven wire screens. Contains illustrations.

Safety. National Safety Council, 20 North Wacker Dr., Chicago 6, Ill.—11 safety

(Continued)

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Hagan Ring Balance Dual Meters

The Ring Balance principle, as developed in Hagan Meters, has many applications other than measurement of flows. Any quantity which can be converted into a pressure differential can be measured by one of these meters. Typical of such measurements are liquid specific gravity, gas density, and liquid level.

Hagan Ring Balance Dual meters are frequently employed to measure flow in combination with some other quantity, recording both measurements on a single chart.

Hagan Dual meters are in use in a number of plants for such services as these:

1. Independent measurement and recording of flow and specific gravity, in processes where the two are related and a record of the relationship is desired.
2. To measure net volume of one constituent in a flowing simple solution in which the specific gravity is a function of the proportion of the mixture.
3. Direct measurement of B.t.u. content of a gas flow, when B.t.u. value is related to gas density.
4. Measurement of liquid level corrected for the net density of the liquid under high pressure.

Automatic compensation for temperature or pressure or both may be provided. Corrected flow may be automatically totalized by means of a built-in integrator.

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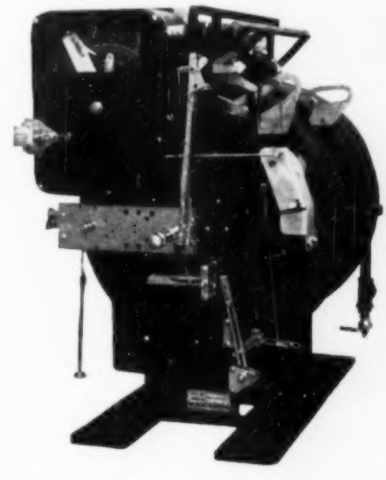
For detailed information concerning these or other applications of Hagan Ring Balance Meters, fill in the coupon below or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.



Hagan Ring Balance meter used to measure flow and specific gravity. Flow, corrected for specific gravity, is recorded and automatically totalized. Specific gravity is also recorded. On meters of this type, record of uncorrected flow can be added if desired.

Hagan Corporation
Ring Balance Meter Division
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graphs are available from the council. They are visual aids in training small groups and discuss safety in connection with such subjects as operating a power press, working with grinders, lifting.

Packaging. Hinde & Dauch Paper Co., Sandusky, Ohio—16-page pocket-sized booklet entitled "How to Stack & Load Corrugated Shipping Boxes."

Coal. Geo. P. Reintjes Co., 2517-19 Jefferson St., Kansas City, Mo.—4-page Bulletin 149 describes furnaces built by this company to promote maximum heat production from burning coal.

Color Guide. Arco Co., 7301 Bessemer Ave., Cleveland 4, Ohio—An "Optonic Color Compass" is a device to help in the choice of the most advantageous colors which can be used in a given setting, like a mill, institution, commercial building.

Toxaphene. John Powell & Co., Inc., Technical Service Dept., 1 Park Ave., New York 16, N. Y.—8-page data sheet covering physical and chemical data, analytical procedures, and labeling information of interest to insecticide formulators.

Acid Hose. B. F. Goodrich Co., Akron, Ohio—4-page catalog section No. 3440 recommends uses to which standard hose should be put. Lists temperatures and pressures of various acids which give longest life to hose.

Chemicals. Koppers Co., Inc., Chemical Division, Pittsburgh 19, Pa.—24-page Bulletin No. C-9-130 describes mono-tert-butyl-meta-cresol, a synthetic organic chemical. Gives properties and describes its use as a germicide.

Instruments. Layne & Bowler, Inc., P. O. Box 215 Hollywood Station, Memphis 8, Tenn.—40-page pocket-sized booklet covers an instrument for measuring flow of water through pipe orifices.

Electrical Specialties. Trumbull Electric Mfg. Co., Plainville, Conn.—4-page Circular 152 contains installation pictures of this company's voltage regulator.

Valves. Stockham Valves & Fittings, Inc., Birmingham, Ala.—85-page Catalog 49 V contains technical and statistical information on bronze and iron body valves.

Conveyors. Rapids-Standard Co., Inc., Dept. FJ-138, 342 Rapistan Bldg., Grand Rapids 2, Mich.—4-page Form FVA-149 illustrates and describes the working and use of this company's interfloor power belt conveyor.

Instruments. Meylan Stopwatch Co., 264 West 40th St., New York 18, N. Y.—8-page folder catalogs a line of stop watches and timers.

Process Equipment. Omega Machine Co., 9 Codding St., Providence, R. I.—4-page Bulletin 60-E1A contains diagrammatic views of various applications of the company's feeder for liquids.

Coal. Link-Belt Co., 300 West Michigan Ave., Chicago 1, Ill.—28-page Book No. 2355 contains installation views and flow-sheet diagrams suggesting methods of handling and preparing coal at the mine.

Paint. New Jersey Zinc Co., 160 Front St., New York 7, N. Y.—This company has produced a color and sound motion picture called "The Paint Film." Its purpose is to teach consumers how to get the best service out of factory mixed paints.

Alloys. Titan Metal Mfg. Co., Bellefonte, Pa.—4-page folder sets forth chemical composition of ten brass and bronze alloys used in forging rods and shapes.

Carbon Specialties. National Carbon Co., Room 1328, 30 East 42nd St., New York 17, N. Y.—Descriptive folder covers this company's ground anodes and backfill material for use in cathodic protection and electrical grounding. Contains tables for type, size and quantity of ground anodes and the amount of backfill required.

Government Procurement. Trilane Associates, U. S. Government Procurement Service, 1 Hudson St., New York 13, N. Y.—Brochure is titled "Short-cuts to Successful Bidding and Successful Execution of Valuable Government Contracts." Edited

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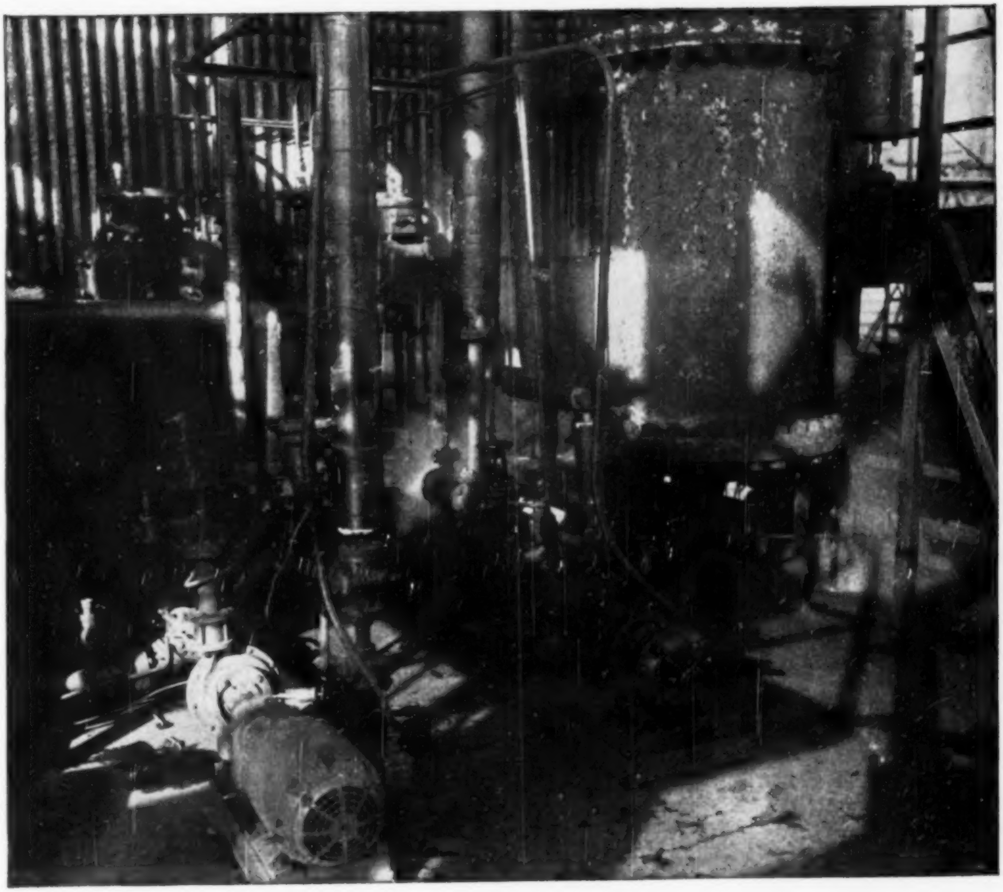

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Creosote tar acid oil, heated to 550° F., is handled at a 60-foot head by the two LaBour pumps at the right in the above picture. The other two LaBour pumps are moving carbolic acid at 250° F.

LaBour pumps won these jobs because of the user's experience with other LaBour pumps; they provide maximum assurance against process interruptions due to untimely pump failure. Extreme simplicity of LaBour design eliminates trouble-breeding complications. Thorough-going care in building—checked step by step with elaborate tests including actual operation under specified head and capacity conditions before shipment—reduces the possibility of service difficulties to the vanishing point.

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LaBour
CENTRIFUGAL PUMPS

THE LABOUR COMPANY, Inc. • ELKHART, INDIANA, U.S.A.

principally from the suppliers' point of view.

Photographic Reproduction. Industrial Photographic Division, Eastman Kodak Co., 343 State St., Rochester 4, N. Y.—72-page handbook entitled "How to Use Kodagraph Reproduction Materials." Diagramatically illustrates methods of copying various types of drawings and of restoring or revising old, stained, or faded drawings. Priced at 50 cents.

Heavy Duty Cylinder. Ledeen Mfg. Co., 1600 South San Pedro St., Los Angeles 15, Calif.—2-page flyer describes pneumatically operated cylinders for pushing, pulling, lifting, lowering, squeezing, etc.

Safety Tools. Ampco Metal, Inc., Milwaukee 4, Wis.—28-page Catalog No. 119 illustrates and describes the line of safety tools produced by this company.

Process Equipment. Burgess-Manning Co., Libertyville, Ill.—5 leaflets describe and illustrate the applications of the noise mufflers made by this company. Bulletins are Nos. 465, 484, 485, 494 and 497.

Process Equipment. Sutorbilt Corp., 2008 East Slauson Ave., Los Angeles 11, Calif.—Two flyers describe the line of process equipment produced by this company. No. 83 covers the rotary gas pump and pneumatic unloading system. No. 69A catalogs such equipment as blowers, fans and exhausters, air conveyors etc.

Packaging. Hinde & Dauch Paper Co., Sandusky, Ohio. — 28-page pocket-sized booklet entitled "How to Use Color on Corrugated Boxes" discusses the results of studies made by this company on the uses of color in packaging.

Filters. Dollinger Corp., 11 Centre Pk., Rochester 3, N. Y.—8-page booklet describes the automatic filters produced by this company. Contains a sectional view illustrating construction and operation.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—20-page Bulletin ND44-96-708 illustrates and describes this company's pneumatic and electric instruments for regulating the pH of industrial wastes.

Process Equipment. Allis-Chalmers Mfg. Co., 1147 South 70th St., Milwaukee, Wis.—Two booklets describing and illustrating the construction features of equipment made by this company. Bulletin 05B6112A covers synchronous motors; Bulletin 05B-6031B covers alternating-current, high-speed, and coupled-type generators.

Elevators. Barrett-Cravens Co., 4609 South Western Blvd., Chicago, Ill.—36-page Bulletin 10482 describes the complete line of elevators and portable cranes produced by this company. Contains specifications and illustrations for the various models.

Clad Steels. Lukens Steel Co., Coatesville, Pa.—8-page Bulletin No. 492 entitled "Product and Equipment Protection for the Soap Industry" shows applications of this company's clad steels in the soap industry.

Cork Products. Korfund Co., Inc., 48-36-D, 32nd Pl., Long Island City 1, N. Y.—4-page Catalog C-1 illustrates and describes examples of machines which may be isolated with cork produced by this company.

Instruments. The Bristol Co., Waterbury 91, Conn.—Bulletin 138 describes the application of this company's automatic pH recording and controlling instruments and recording flowmeters.

Power Belts. Manheim Mfg. & Belting Co., Manheim, Pa.—4-page brochure lists this company's line of balata belting and is complete with data tables.

Fan Heater. Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.—2-page Bulletin No. 109 describes one of this company's high pressure steam fan heaters. Flowchart is included in the bulletin.

Crushers. Allis-Chalmers, Wilwaukee 1, Wis.—4-page Pamphlet 07B6425A describes in detail this company's fine-reduction crushers. Sizes vary from ¼ in. to 1½ in.

Corrosion-Resistant Piping Material. Crane Co., 836 South Michigan Ave., Chicago, Ill.—32-page Circular No. 320, includes this company's complete line of corrosion-resistant piping materials for different indus-

(Continued)

tries. Booklet also gives recommendations for equipment to be used under different conditions.

Pumps. Denver Equipment Co., Box 5268, Denver 17, Colo.—2-page Bulletin PG-B1 describes company's diaphragm pump and vertical centrifugal sand pumps.

Heavy Plant Equipment. Matt Corcoran & Co., Louisville, Ky.—13-page pamphlet describes the various types of heavy plant equipment produced by this company. Engineering data is included.

Electrodes. Lincoln Electric Co., Cleveland 1, Ohio.—4-page flyer cataloging the line of hardsurfacing electrodes, made by this company, and describing their uses and procedures.

Process Equipment. Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.—Two 2-page flyers illustrating and describing the line of equipment produced by this company. Bulletin No. C12-B7 covers jaw crushers. Bulletin No. 83-B8 covers vibrating screens.

Hydraulic Cells. Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42, Pa.—8-page Bulletin No. 288 describes and illustrates with labeled schematic drawings and photographs the hydraulic cells made by this company. These cells are for general industrial weighing and special laboratory testing equipment and range in capacity from 10,000 to 100,000 lb.

Electric Switches. Micro Switch, Freeport, Ill.—Two 2-page flyers describe the features and illustrate the construction of the die cast enclosed switches made by this company.

Strainers. Edward Valves, Inc., East Chicago, Ind.—4-page Bulletin 712 gives dimensions and weights, correct installation, maintenance, and cleaning of the forged steel strainers produced by this company.

Silicone Oils. General Electric, Pittsfield, Mass.—Report describes physical properties of all nine silicone liquids produced by this company. Includes data on viscosity-temperature, expansion coefficients, refraction indexes, specific gravities, etc.

Jaw Crushers. Allis-Chalmers Mfg. Co., South 70th St., Milwaukee, Wis.—4-page Bulletin O7B7090 provides data on capacities, general dimensions and applications of the line of jaw crushers produced by this company.

Concrete Flooring. Floor Material Industries, 630 Fifth Ave., New York 20, N. Y.—16-page booklet, File No. 23, entitled "Materials for Better Floors." Gives data on various materials used in the construction of floors and outlines procedure for laying them.

Rock Cork. Johns-Manville, 22 East 40th St., New York 16, N. Y.—4-page leaflet provides such information as sizes, temperature limits, conductivity, and moisture absorption of rock cork, a mineral insulation made by this company.

Ethyl Cellulose. Hercules Powder Co., Wilmington, Del.—Booklet entitled "Ethyl Cellulose, Properties and Uses." Contains data on the properties, formulations and specific applications of ethyl cellulose which is made by this company.

Chromium-Iron. Babcock & Wilcox Tube Co., Beaver Falls, Pa.—30-page Bulletin TR-506 covers the properties at elevated temperatures, impact properties and notch sensitivity, structural characteristics etc. of the chromium-iron which is produced by this company.

Stainless Steel Specialties. Allmetal Screw Products Co., 33 Greene St., New York 13, N. Y.—89-page Catalog No. 49 describing the stainless steel fastening devices and other stainless steel parts made by this company.

Process Equipment. J. H. Day Co., Cincinnati 22, Ohio.—20-page Bulletin 456 describing the roller mills and mixers made by this company. Illustrations include photographs and schematic drawings.

Heaters. Allis-Chalmers Mfg. Co., South 70th St., Milwaukee, Wis.—12-page Bulletin 15B6431A illustrates and describes the high frequency dielectric heaters made by this company. Pictures applications and features of equipment.

—*End*

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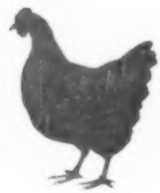

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Chemical Economics

RICHARD F. WARREN, Assistant Editor

Business Outlook Brightens as Fall Upswing Is Expected

Amid the first returns on second quarter business which showed large firms like Du Pont registering substantial profits, optimistic attitudes on production outlook reappeared. Some of the chemical consuming industries that have been hard hit by the current readjustment began to show signs of economic improvement in July.

Dow's top executives joined the optimists in their annual report. Leland I. Doan said that the recent swing to highly competitive business constitutes a return to the way of industrial life to which the United States has attributed all its unrivaled economic and industrial progress. The Dow president announced record earnings for the third consecutive year, and stated in the report that Dow management cannot be other than optimistic under present conditions.

It looks like textiles hit bottom in May. Sales managers are reporting better wool sales in July. Cotton consumption was up over 20,000 bales in June compared with May. Rayon yarn deliveries were up 14 percent over May rates. However this was still 27 percent below the figure quoted for rayon operations for the corresponding 1948 period.

Leather industry also appears to be getting back on its feet. Tanners Council estimates that shoe output in June was almost 7 percent above June 1948 rates and this July is expected to be well ahead of July 1948 levels. Another good sign: Endicott Johnson reopened its sole-leather tannery for full operations this month.

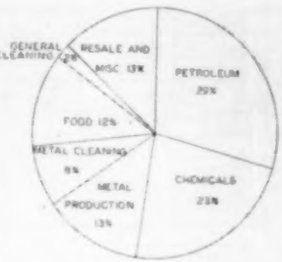
Worry over low steel inventories became evident in July when steel supplies were threatened by a strike. Steel firms report that the strike threat stimulated orders as consumers scurried to make sure they would not be caught short of this material.

All these factors add up to better markets for chemicals than some of the more pessimistic guesstimators have been predicting.

More capacities for ammonia production have arrived on the scene this summer. Both Lion and Phillips have considerably increased their plants. Phillips has doubled its capacity at Etter. Lion's expansion will bring its daily capacity up to 570 tons per day.

Rubber Business Back

June consumption of rubber was about 4 percent above May rates, with a uniform growth reflecting better business in the natural, synthetic, and reclaimed rubber sectors of this part of the chemical process industries. However, the rubber business is down from last year levels. Synthetic is off 5 percent, natural rubber use is 14 percent below June 1948 rates and reclaimed rubber consumption is almost 20 percent below operating levels reached last year. In the first six months of this year synthetic rubber consumption was 218,938 long tons. This is 3 percent below the same 1948 period. Natural rubber slipped back 9 percent in the first six months as 291,056 long tons found its way into domestic products. Reclaimed rubber took the biggest slump in this period. From January to June industry used 112,295 long tons of this material—that was 20 percent below the 1948 period.



Hydrochloric Acid Uses

At the recent Commercial Chemical Development Association meeting, an interesting paper, written by L. S. Roehm and G. R. Anderson of Dow Chemical Co., gave a much sought after breakdown of hydrochloric acid end-uses. The accompanying pie chart shows the distribution of acid, excluding HCl used by producers. Biggest consumer is the petroleum industry which uses huge amounts for acidizing oil wells. Other large uses include ethyl chloride, an intermediate in tetraethyl lead production. Number two consumer according to Roehm and Anderson is the chemical industry. Here the acid is used in dyes, intermediates, chlorinated hydrocarbons and metal chlorides.

Metal production and refining consume about 13 percent of the total acid sold. It is used in refining nonferrous metals and in the recovery of non-ferrous metals from scrap. Metal cleaning for finishing operations such as galvanizing, enameling and electroplating use about 8 percent. The food industry takes about 12 percent of the acid. Largest use in this field is in hydrolysis of starch in dextrose production. Considerable quantities also are used in making sodium monoglutamate. This use has grown rapidly in recent years.

The authors also pointed out that future production of hydrochloric acid will depend on the production of chlorinated hydrocarbons. It doesn't look like production from sulphuric acid and salt will increase unless new markets are developed for salt cake. Production of HCl from chlorine and hydrogen probably will not grow unless caustic soda supplies tighten up again.

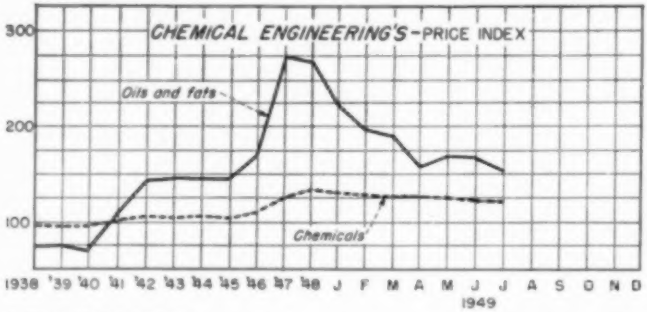
Future development of HCl is tied to events in its own production and end-use fields as well as problems in production and marketing of salt cake, caustic soda and a multitude of organic chlorine compounds. If byproduct hydrochloric acid becomes a general source of chlorine, a shortage of acid could result. However, a corresponding drop in caustic soda production could make the synthetic process for hydrochloric acid very attractive in some parts of the United States.

Price Trends Mixed

Some solvents such as butyl alcohol dropped off last month. Ethyl acetate slipped off to 9c per lb. in July. China wood, palm, red, and linseed oils dropped during July. On the up side were cottonseed and corn oils. Market for coconut oil was strong in the early part of the month. The chemicals price index was up on August 1, due to rising lead and zinc pigment prices. (See page 300.)

PRICE, CONSUMPTION AND PRODUCTION TRENDS

PRICES

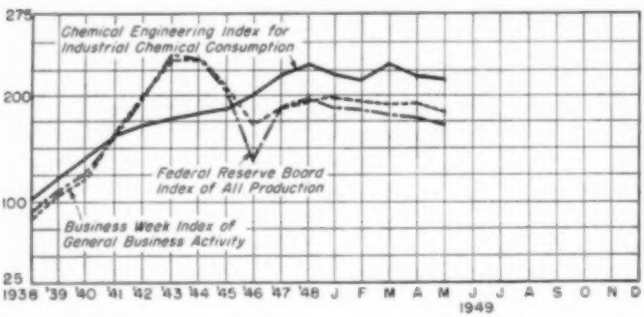


Chemical Engineering's Price Index
A month, a year, and two years ago

	Chemicals	Oils & Fats
As of August 1	**123.33**	**156.12**
Last Month	122.64	156.86
August 1948	133.04	261.32
August 1947	122.17	222.95

1937 = 100

CONSUMPTION

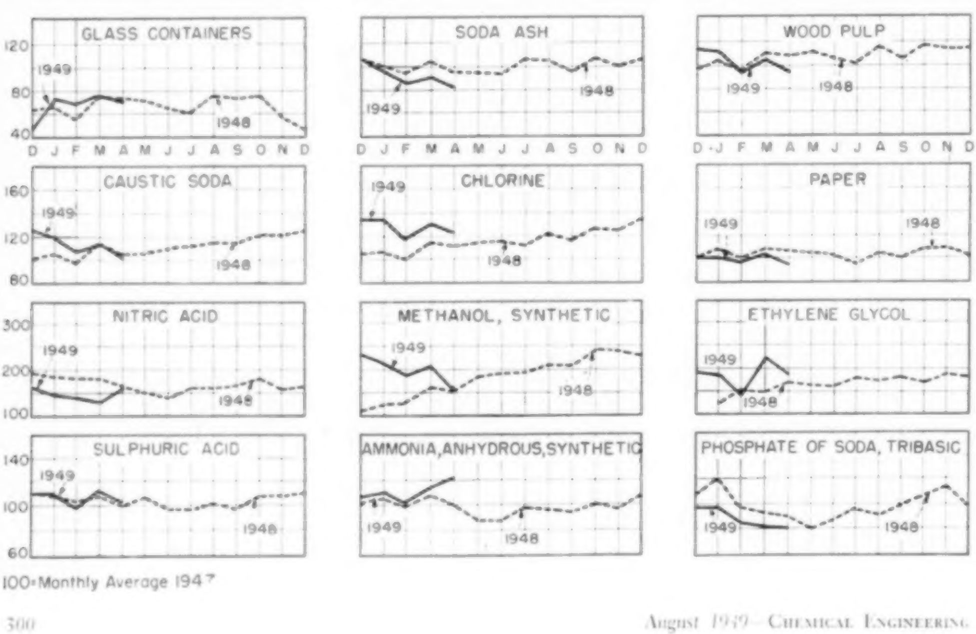


Chemical Engineering's Consumption Index
(A breakdown by consuming industries)

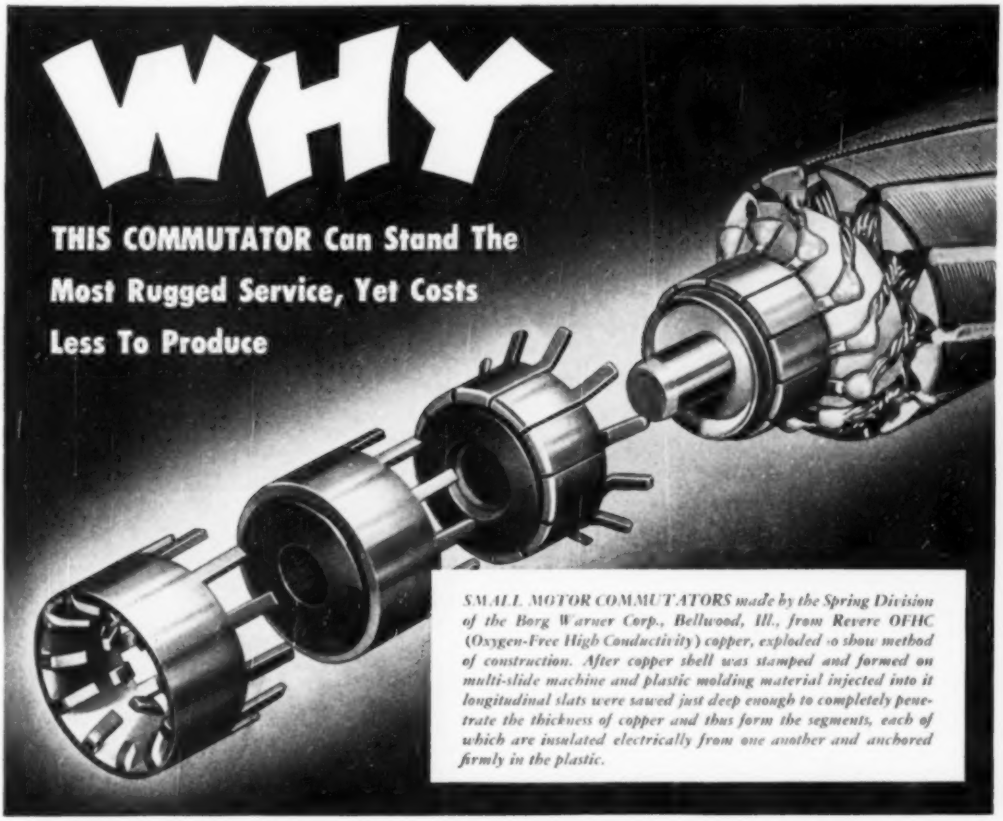
	April (Revised)	May
Fertilizers	59.95	56.40
Pulp and paper	21.25	21.02
Petroleum refining	20.10	21.04
Glass	16.60	17.81
Paint and varnish	24.01	24.75
Iron and steel	14.28	14.10
Rayon	19.65	19.11
Textiles	7.99	8.02
Coal products	10.86	10.98
Leather	4.21	4.02
Explosives	7.77	8.44
Rubber	4.85	4.68
Plastics	8.65	7.84
INDEX	220.17	218.21

1935 = 100

PRODUCTION



100=Monthly Average 1947



SMALL MOTOR COMMUTATORS made by the Spring Division of the Borg Warner Corp., Bellwood, Ill., from Revere OFHC (Oxygen-Free High Conductivity) copper, exploded to show method of construction. After copper shell was stamped and formed on multi-slide machine and plastic molding material injected into it longitudinal slats were sawed just deep enough to completely penetrate the thickness of copper and thus form the segments, each of which are insulated electrically from one another and anchored firmly in the plastic.

IT was quite a complex problem the Spring Division of Borg Warner Corp. dropped into the lap of Revere's Technical Advisory Service. They were getting set to manufacture commutators for small motors and they wanted to select the best material for the job.

Here were the specifications: The material had to be the hardest possible yet still able to take the extremely severe forming operation which was to be done in a multi-slide machine. High hardness was necessary in order to combine maximum wear resistance with the ability to withstand the extreme centrifugal force developed in small motors operating at high speeds. In addition, in the molding operation, which is done after the copper shells have been formed, it was necessary to hold the diameter of the shell to within .001" in order to prevent the plastic from flowing between the mold and the outer surfaces of the commutator. An equal tolerance was also imposed upon the height of the solid cylindrical portion for the same reason. Also of great importance was the need for the cylinder wall being almost absolutely flat.

Because of long experience with somewhat similar problems Revere recommended trial of OFHC (Oxygen-Free High Conductivity) copper, four numbers hard. This was tested along with several other metals. The OFHC alone was found to produce excellent parts, and with tolerances so close as to be almost unbelievable in this type of operation. All other types of copper failed at the very sharp bend where the anchoring lugs join the side of the shell.

An unusual feature of these commutators is the plastic material used in the core. Tough, and unusual in composition, it serves both as insulation and as a mechanical connection between commutator and shaft without use of a bushing and key.

To determine if these commutators could *really* take it, test motors in which they were used were speeded up to 35,000 rpm. Although the wiring in the rotors practically exploded at that speed, there were no failures in the commutators, Temperature tests up to 400° F. were also made. Here again there was no damage to the commutator, though the rotor wiring was badly damaged due to the combination of centrifugal force and decrease in wire strength. Once again the unusual combination of properties of Revere OFHC copper had played a part in helping another one of the country's leading manufacturers produce an outstanding product at less cost.

Perhaps this or some other Revere Metal can be of help in improving your product—cutting your production costs. Toward that end we suggest that you get in touch with your nearest Revere Sales Office.

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(Continued)

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of acetate rayon annually were soon consumed. Then, military requirements increased rapidly from about 8 million pounds to 30 million in order to make shroud lines and rope, tapes and webbing, electric insulation, and cords, ribbons and insignia. Supplies of approximately 5 million pounds for house furnishings were soon eliminated. The residue, varying from 150 to 167 million pounds were assigned to apparel needs. When it is considered that the demand for clothes of all kinds was at unprecedented levels, some civilian hardship resulted.

There was very little to be done about it. Plant expansion necessitated iron, steel, pipe and instruments needed for a thousand military projects.

The industry turned to wood pulp in order to extend the linters then available. No way was found to increase the anhydride supply. Of the total produced, 25 percent derived from ethanol, 20.5 percent from propylene, nearly 23 percent from cal-

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John R. Skeen is market research director for Foster D. Snell, Inc.

Rayon uses most cellulose acetate. Raw materials are acetic anhydride and cellulose.

	Cellulose Acetate Rayon								Raw Materials	
	Production[1]									
	Total	Yarn	Staple	Capacity[2]	Producers[3] (Number)	Plants[3] (Number)	Textile Share[4] (% Fibers)	Price[5] (150d.)	Acetic Anhydride[6]	Cellulose[7]
1933	41.1	41.1	....	45	5	5	1.14	$0.90-1.00	64	25
1934	38.0	38.0	....	...	...	...	1.22	0.78-0.65	59	23
1935	55.8	55.5	0.3	83	4	4	1.62	0.60	87	34
1936	85.2	62.7	2.5	...	5	5	2.04	0.60	132	51
1937	86.0	82.4	3.6	...	5	5	1.97	0.63	133	52
1938	79.6	76.1	3.5	100	5	5	2.26	0.54-0.52	123	48
1939	103.3	97.3	6.0	121	5	5	2.34	0.56-0.54	160	62
1940	143.5	133.0	10.5	149	...	...	2.95	....	222	86
1941	180.4	163.7	16.7	183	...	...	2.81	0.56	280	108
1942	194.5	168.8	25.7		...	...	2.83	0.56	301	117
1943	195.0	162.6	32.4	208	5	6	2.96	0.56	302	117
1944	212.0	171.7	40.3	215	5	6	3.45	0.56	329	127
1945	214.2	174.9	39.3	...	5	6	3.57	0.56	332	129
1946	230.0	186.3	43.7		...	...	3.57	0.63	357	138
1947	281.8	221.5	60.2	310	...	...	4.37	0.67	437	169
1948	377.5	293.8	83.7	388	4	7	5.90	0.74	585	227
1949	242.4	209.0	33.4	454	4	7	....	....	376	146

Unit: millions of pounds. [1]*Rayon Organon*; 1949 values based upon average deliveries January-May. [2]Developed from historical record; 1948-49: *Rayon Organon*. [3]Lustron Co.: 1914-1929, Boston, patents of Mork, Little & Walker later acquired by Celanese Corp. of America; Celanese began at Cumberland, Md. 1926 and in recent years added plants at Narrows, Va., and Rock Hill, S. C., and acquired the Tubize plant at Rome, Ga.; in 1929, American Viscose Corp. began at Meadville, Pa., E. I. du Pont de Nemours Co. at Waynesboro, Va.; in 1930, Tennessee Eastman Corp. began at Kingsport, Tenn., and Tubize Chatillon Corp. at Rome, Ga. [4]Production of acetate yarn and staple as percent of mill consumption of U. S. and foreign cotton, total wool consumption plus raw mohair and camel's hair, and total domestic production of all types of rayon; for assembled data see *ACE-93* Revised, June 1948, Southern Regional Research Laboratory, Dep't. of Agriculture; for 1947-8, data are closely approximate only. [5]Numerous sources including *Rayon Organon*; represents price for 150 denier as announced as of specific dates. [6]Total as used; estimates only as based upon five series of data; factors vary widely with time and conditions; presently variations by company are about ±3%. [7]Linters and wood pulp; calculated on the basis of 0.601 lb. of linters per lb. rayon; until war years linters only was used.

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Commodity Survey:

CELLULOSE ACETATE RAYON

JOHN R. SKEEN

With a domestic commercial history of slightly more than 20 years, cellulose acetate rayon accounts for nearly 6 percent of the consumption of the major textile fibers—cotton, wool, and rayons of all types. This represents 2.5 times the share of only a decade ago and was achieved by quadrupling the output. Until recently there appeared to be no limit to the demand for acetate rayon. However, the trend has changed and the industry has been operating at less than 60 percent of capacity recently.

Cellulose acetate rayon found its greatest market in the making of fabrics for apparel, especially women's wear. The supply of these "quality goods" has generally been inadequate. By 1942 the situation assumed serious proportions. The deficit exceeded 30 million pounds and continued without abatement until last year. There were many contributing reasons. For instance, the War Production Board provided in its Conservation Orders M-37 and M-176 for the use of acetate yarn and staple fiber in small amounts to replace silk and nylon in hosiery and fabrics, and wool in worsteds. About 10 million pounds of acetate rayon annually were soon consumed. Then, military requirements increased rapidly from about 8 million pounds to 30 million in order to make shroud lines and rope, tapes and webbing, electric insulation, and cords, ribbons and insignia. Supplies of approximately 5 million pounds for house furnishings were soon eliminated. The residue, varying from 150 to 167 million pounds were assigned to apparel needs. When it is considered that the demand for clothes of all kinds was at unprecedented levels, some civilian hardship resulted.

There was very little to be done about it. Plant expansion necessitated iron, steel, pipe and instruments needed for a thousand military projects.

The industry turned to wood pulp in order to extend the linters then available. No way was found to increase the anhydride supply. Of the total produced, 25 percent derived from ethanol, 20.5 percent from propylene, nearly 23 percent from calcium carbide, and about half from acetic acid. The critical chemicals were ethanol, carbide and prime acetic acid, all exhibiting acute deficits in spite of every effort to increase production. Accordingly, no significant expansion in acetate rayon occurred until 1946.

Cellulose acetate is made by mixing acetic anhydride, glacial acetic acid, and sulphuric acid (as a catalyst) in a glass-lined acetylator. After cooling, the cellulose component is added and the low temperature reaction continues for over five hours. The viscous fluid is then diluted with acetic and sulphuric acids and aged for about 15 hrs. after which it is well mixed in a large volume of water. The flakes are washed several times and dried. The spinning solution is made by dissolving the flakes in acetone. The solution is pumped through variously small holes in a cap formed of thin metal—the spinneret. The size of the holes determines the denier of the effluent. Filaments of yarn so formed drop through a tube with a countercurrent of warm air. The dry filaments are gathered at the bottom of the drying tube and form the thread which is wound on a bobbin. If the threads are gathered together and twisted before winding, the product is known as "filament yarn," composed of a specified number of filaments of given diameter (in terms of denier). If the threads are grouped in parallel, substantially without twisting, they are called "tow." Tow is subsequently cut in lengths of one to seven inches for consumption as "staple fiber."

Rayons are the result of the desire for artificial silk. Robert Hook anticipated it in 1664 but first experiments appear to have been made 71 years later by Reamur in France. Thus, gums and resins were forced through orifices and coagulated into threads. Schoenbein nitrated cellulose in the year 1845.

Forty years later Swan exhibited in London fabrics woven from collodion fibers. It is said that a process for the acetylation of cellulose was known in 1865 but 30 years passed before the Cross and Bevan patents were issued. These claimed the use of acetate for making filament for incandescent gas lamps. In 1902 a domestic patent was issued to Mork, Little and Walker for the application in making textile fibers from cellulose acetate. Experimental production began in Boston by the Lustron Co. and ended in bankruptcy after 15 precarious years.

France is identified with the development of three rayon processes: cellulose nitrate, cuprammonium and cellulose acetate. Two major patent systems soon developed respecting the acetate product and both were dom-

(Continued)

JOHN R. SKEEN is market research director for Foster D. Snell, Inc.

Rayon uses most cellulose acetate. Raw materials are acetic anhydride and cellulose.

	Cellulose Acetate Rayon								Raw Materials	
	Production[1]			Capacity[2]	Producers[3] (Number)	Plants[3] (Number)	Textile Share[4] (% Fibers)	Price[5] (150d.)	Acetic Anhyrided	Cellulose[7]
	Total	Yarn	Staple							
1933....	41.1	41.1	....	45	5	5	1.14	$0.90-1.00	64	25
1934....	38.0	38.0	....	...	...	...	1.22	0.78-0.65	59	23
1935....	55.8	55.5	0.3	83	4	4	1.62	0.60	87	34
1936....	85.2	62.7	2.5	...	5	5	2.04	0.60	132	51
1937....	86.0	82.4	3.6	...	5	5	1.97	0.63	133	52
1938....	79.6	76.1	3.5	100	5	5	2.26	0.54-0.52	123	48
1939....	103.3	97.3	6.0	121	5	5	2.34	0.56-0.54	160	62
1940....	143.5	133.0	10.5	149	...	...	2.95	....	222	86
1941....	180.4	163.7	16.7	183	...	...	2.81	0.56	280	108
1942....	194.5	168.8	25.7		...	...	2.83	0.56	301	117
1943....	195.0	162.6	32.4	208	5	6	2.96	0.56	302	117
1944....	212.0	171.7	40.3	215	5	6	3.45	0.56	329	127
1945....	214.2	174.9	39.3	...	5	6	3.57	0.56	332	129
1946....	230.0	186.3	43.7	...	...	...	3.57	0.63	357	138
1947....	281.8	221.5	60.2	310	...	...	4.37	0.67	437	169
1948....	377.5	293.8	83.7	388	4	7	5.90	0.74	585	227
1949....	242.4	209.0	33.4	454	4	7	....	....	376	146

Unit: millions of pounds. [1]*Rayon Organon*; 1949 values based upon average deliveries January-May. [2]Developed from historical record; 1948-49: *Rayon Organon*. [3]Lustron Co.: 1914-1929, Boston, patents of Mork, Little & Walker later acquired by Celanese Corp. of America; Celanese began at Cumberland, Md. 1926 and in recent years added plants at Narrows, Va., and Rock Hill, S. C., and acquired the Tubize plant at Rome, Ga.; in 1929, American Viscose Corp. began at Meadville, Pa., E. I. du Pont de Nemours Co. at Waynesboro, Va.; in 1930, Tennessee Eastman Corp. began at Kingsport, Tenn., and Tubize Chatillon Corp. at Rome, Ga. [4]Production of acetate yarn and staple as percent of mill consumption of U. S. and foreign cotton, total wool consumption plus raw mohair and camel's hair, and total domestic production of all types of rayon; for assembled data see *ACE-93* Revised, June 1948, Southern Regional Research Laboratory, Dep't. of Agriculture; for 1947-8, data are closely approximate only. [5]Numerous sources including *Rayon Organon*; represents price for 150 denier as announced as of specific dates. [6]Total as used; estimates only as based upon five series of data; factors vary widely with time and conditions; presently variations by company are about ±3%. [7]Linters and wood pulp; calculated on the basis of 0.601 lb. of linters per lb. rayon; until war years linters only was used.

mated by the French Comptoir des Textiles Artificiels. Thus, there were Ursines du Rhone, later Rhone-Poulene, with its subsidiary, Societe Rhodiaceta, and Fabrique de Soi Artificielle de Tubize of Brussels. A third may be mentioned, Chatillon S.A. Italiana per le Fibre Tassili Artificiali founded in 1918 by Banca Commerciale.

The domestic pioneer was the American Cellulose and Chemical Manufacturing Co.—later Celanese Corp. of America—organized at government request in 1918 to supply acetate "dope" for airplanes. Following the war the Lustron patents were acquired and British Celanese was licensed by Tubize. After a few years of development the domestic firm offered its product for sale in 1926. It was a phenomenal success. As a result others became interested. E. I. du Pont de Nemours & Co. obtained the rights to the Rhodiaceta process and built a new plant at Waynesboro, Va. The production of Acele began in 1929. The previous year, American Chatillon Corp. began at Rome, Ga., with a capacity of a half million pounds. This company later combined with the Tubize Artificial Silk Co. and the operation was acquired by Celanese in 1945. The American Viscose Co. bought the process rights controlled by Courtaulds of England and began operations at Meadville, Pa., with a capacity of 5 million pounds of Seraceta. In 1930 the Tennessee Eastman Corp. was producing at Kingsport, Tenn.

Selling at nearly double the price of viscose rayon, and with so many technical difficulties to overcome, the early success of acetate rayon is unusual. New dies were needed. British Celanese Ltd. produced 14 of them, first made in the U. S. in 1925. The Geigy Co. offered the competitive Setacyl colors in the same year. Then the spinners and weavers were resistant to change. They were sold on the basis of superior quality. Price remained high. This was due in great part to the expense for acetic anhydride. This sold from 30 to 40 c. per lb. during the first years of acetate rayon production. In 1935 the Carbide and Carbon Chemicals Corp. began production of anhydride on a large scale and offered it at 12 c. in tanks with the added advantage of being a purer product. Price was further reduced over the years.

Celanese has been the largest producer of acetate rayon with a capacity varying from 40 to 60 percent of the total over the past 15 years. Tennessee Eastman is next in output followed by American Viscose and Du Pont.

—*End*

United States Production of Certain Chemicals

Chemical (Tons unless otherwise noted)	April 1949	April 1948	March 1949	March 1948
Ammonia, synthetic, anhydrous[1]	109,306	92,640	103,418	100,142
Ammonium nitrate	93,726	79,976	85,079	95,407
Ammonium sulphate, synthetic (M lb.)	63,106	28,480	56,982	28,779
Calcium arsenate (M lb.)	1,159	3,910	129	3,379
Calcium carbide, commercial	50,763	57,640	58,123	61,480
Carbon dioxide:				
Liquid and gas (M lb.)	18,792	19,545	21,127	20,511
Solid (M lb.)	56,966	63,715	52,128	50,079
Chlorine	140,791	126,992	148,693	132,668
Chrome green (M lb.)	530	1,196	539	1,240
Chrome yellow and orange, (C.P.) (M lb.)	1,773	4,925	2,061	4,886
Hydrochloric acid	40,060	36,306	42,530	36,579
Hydrogen (M cu. ft.)	2,196	2,244	2,281	2,298
Lead arsenate, acid and basic (M lb.)	1,627	3,814	2,833	3,654
Molybdate chrome orange, (C.P.) (M lb.)	316	518	285	474
Nitric acid	101,804	94,904	85,680	101,041
Oxygen (M cu. ft.)	1,367	1,362	1,363	1,361
Phosphoric acid (50 percent H_3PO_4)	108,464	97,510	114,237	105,097
Soda ash:				
Ammonia-soda process:				
Total wet and dry[2]	312,647	357,752	349,849	404,525
Finished light[3]	163,552	177,047	198,123	202,795
Finished dense	107,737	120,808	102,002	134,765
Natural[4]	14,478	26,298	15,837	23,896
Sodium bicarbonate, refined	11,874	12,806	13,903	14,698
Sodium bichromate and chromate	7,105	8,184	8,116	7,971
Sodium hydroxide:				
Electrolytic process:				
Liquid[5]	128,933	124,002	138,982	130,292
Solid	21,385	20,732	23,492	24,297
Lime-soda process:				
Liquid[5]	46,917	62,298	53,965	68,366
Solid	15,810	19,013	18,232	21,982
Sodium phosphate:				
Monobasic	985	781	948	1,194
Dibasic	9,844	7,045	10,336	8,546
Tribasic	5,548	6,116	5,509	6,345
Meta	2,677	3,179	1,791	3,461
Tetra	5,568	5,057	6,845	6,105
Sodium silicate, anhydrous	32,579	38,773	36,892	54,702
Sodium sulphate:				
Anhydrous	9,831	15,079	11,826	14,220
Glauber's salt[4]	12,170	15,942	13,554	15,826
Salt cake[4]	48,254	54,986	52,069	53,862
Sulphuric acid[6,7]				
Chamber process	222,714	253,156	252,161	294,954
Contact process, new	624,790	596,047	665,648	614,727

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid materials, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Synthetic Organic Chemicals

	April 1949	April 1948	March 1949	March 1948
Acetanilid	729,711	343,984	911,913	190,955
Acetic acid:				
Synthetic[1]	27,829,105	31,285,949	28,566,334	32,439,136
Recovered	95,924,485	137,955,466	115,099,880	142,867,484
Natural[2]	1,788,256	1,958,270	1,930,060	2,165,385
Acetic anhydride[3]	29,459,463	60,102,859	48,157,275	64,849,357
Acetone	33,683,324	38,478,433	35,655,108	37,766,701
Acetylsalicylic acid	803,773	1,061,005	609,256	1,053,583
Aniline	5,629,461	8,970,426	5,797,816	9,469,356

(Continued on page 308)

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U. S. Production of Synthetic Organic Chemicals, cont. from page 306

Chemical	April 1949	April 1948	March 1949	March 1948
Barbituric acid derivatives:[5]				
5-Ethyl-5-phenylbarbituric acid and salts (phenobarbital)	25,591	21,403	44,151	44,334
Benzene:				
Motor grade:				
Coke oven operators[6]	2,040,613	618,389	1,634,673	833,928
All other grades:				
Tar distillers[4]	654,694	981,687	993,324	1,191,891
Coke oven operators[6]	11,961,006	10,423,913	13,226,288	13,327,285
Butyl alcohol, primary, normal	8,607,646	11,022,463	8,995,367	10,619,183
Carbon bisulphide	26,753,622	30,358,268	31,832,327	33,374,258
Carbon tetrachloride	14,653,507	18,416,603	19,742,594	17,327,714
Chlorobenzene, mono	24,396,096	24,941,890	25,501,511	28,115,482
Creosote oil:				
Tar distillers[4]	11,347,733	9,874,299	11,543,542	8,630,036
Coke open operators[6]	1,901,848	3,009,204	2,317,385	3,548,942
Cresols, meta-para	366,893	803,279	433,667	903,960
Cresols, ortho-meta-para	347,825	583,072	578,920	686,410
Cresylic acid, refined[7,10]	2,189,809	1,870,625	2,493,121	2,287,487
Dibutyl phthalate	1,229,890	1,166,424	1,450,954	1,259,130
Dichlorodiphenyltrichloroethane (DDT)	3,063,663	1,891,075	3,568,457	2,002,469
Ethyl acetate (85 percent)	6,436,267	5,422,126	6,442,186	5,849,777
Ethylene glycol	36,089,336	28,360,553	38,210,807	28,584,178
Ethyl ether	2,886,238	2,998,092	3,114,633	3,333,390
Formaldehyde, 37 percent by wt.	36,619,300	54,489,472	42,701,699	60,105,226
Hexachlorocyclohexane	1,223,111	1,663,514	1,414,070	1,567,593
Methanol, natural	1,105,102	1,421,431	1,239,416	1,352,601
Methanol, synthetic	68,072,234	69,645,746	93,210,213	72,665,317
Naphthalene:				
Tar distillers, less than 79° C.	8,456,210	15,148,292	11,014,810	19,381,642
Tar distillers, 79° C. and over	6,691,671	9,481,434	6,321,866	8,356,000
Coke-oven operators, less than 79° C	7,706,438	7,151,936	8,846,674	9,008,707
Penicillin and salts[5]	11,364,729	6,946,351	9,662,418	7,843,295
Phenol	22,182,077	23,248,576	21,735,279	26,862,527
Phthalic anhydride	10,192,219	13,071,537	12,470,483	14,082,027
Styrene, government and private plant	32,157,595	32,531,701	34,304,063	30,295,312
Toluene:				
Coke-oven operators	2,520,888	1,959,596	2,621,221	2,456,277
All other[9]	3,281,370	2,966,550	4,278,867	4,656,842
Xylene, crude	3,925,331	5,080,026	4,401,447	5,658,467

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

NEW CONSTRUCTION

Proposed Work

Idaho, Lewiston—Potlatch Forests, Inc., Lewiston, plans the construction of a pulp mill. Estimated cost $2,000,000.

Ill., North Aurora—Armour & Co., Pharmaceutical Div., Union Stock Yards, Chicago, Ill., plans to construct a 1 and 2 story steel plant. Estimated cost $1,500,000.

La., Gretna—Southern Cotton Oil Co., Gretna, plans to construct a gate house with two 1 story, 18x32 ft. wings and a 2 story, 50x100 ft. office building. August Perez & Associates, Audubon Bldg., New Orleans, Archts.

Tex., Baytown—Humble Oil & Refining Co., Baytown, plans to construct a locker plant. Estimated cost $75,000.

Tex., Beaumont—Binswanger & Co. of Texas, 207 North Main St., Houston, plans to construct a 1 story glass distributing plant. Estimated cost $75,000.

Tex., Provident City—Shell Oil Co., Inc., Shell Bldg., Houston, plans to construct a gasoline plant addition to have a daily capacity of 60m. cu. ft. gas. Estimated cost $1,500,000.

Tex., Alba—Alba Oil & Refining Co., plans to construct a crude oil refinery here to have a daily capacity of 1,000 bbl. Estimated cost $1,500,000.

Tex., New Ulm—McCarthy Oil & Gas Corp., Shell Bldg., Houston, plans to construct a gasoline absorption plant and area gas lines. Estimated cost $5,500,000 and $250,000 respectively.

Tex., Sweetwater—Lone Star Cement Corp., First Natl. Bank Bldg., Dallas, Tex., plans to construct a cement plant in this locality. Estimated cost $250,000.

Ont., Fort Burwell—Pennada Oil Refining Co., Ltd., 118 West King St., Chatham, Ont., Can., plans the construction of a 6,000 bbl. oil refinery here. Estimated cost will exceed $500,000.

Ont., Toronto—Lily Cups, Ltd., Listowel, plans the construction of a 1 story plant. Estimated cost $500,000.

Ont., Toronto—Toronto Cadmium Co., Ltd., 21 Edwin Ave., plans to construct a new plant. Estimated cost $75,000.

Que., St. Odilon—St. Lawrence Co., Ltd., c/o Marius Lord, Archt., St. Odilon, plans to construct an asbestos factory. Estimated cost $700,000.

Contracts Awarded

Calif., East Los Angeles—Lever Bros., 216 West 6th St., Los Angeles, have awarded the contract for the design and construction of a group of plant buildings, one wing for soap manufacturing and one for edible products, etc., to Bechtel Corp., 3780 Wilshire Blvd., Los Angeles. Estimated cost $25,000,000.

Conn., Portland—Valley Oil Co., Brownstone Ave., Portland, has awarded the contract for an oil terminal, garage, warehouse and office to Standard Builders, 55 Airport Rd., Hartford. Estimated cost $70,000.

	Current Projects		Cumulative 1949	
	Proposed Work	Contracts	Proposed Work	Contracts
New England		$70,000	$274,000	$1,260,000
Middle Atlantic		1,680,000	158,483,000	8,658,000
South	$68,000	700,000	9,019,000	25,433,000
Middle West	1,500,000	168,000	13,154,000	30,301,000
West of Mississippi	9,150,000	7,324,000	45,503,000	57,366,000
Far West	2,000,000	25,000,000	5,925,000	4,218,000
Canada	1,850,000	920,000	31,165,000	57,190,000
Total	$14,568,000	$35,862,000	$263,613,000	$184,426,000

Del., Seaford—E. I. du Pont de Nemours & Co., Inc., Nemours Bldg., Wilmington, has awarded the contract for a 2 story warehouse to Rupert Construction Co., 3400 Lancaster Ave., Wilmington. Estimated cost $100,000.

Ga., Macon—Burns Brick Co., 10th and Pine Sts., plans to construct an addition to its brick manufacturing plant. Work will be done by force account. Estimated cost $75,000.

Ind., LaPorte—American Rubber Products Co., 315 Brighton St., has awarded the contract for a new factory to Larson Danielson Construction Co., 302 Tyler St. Estimated cost $100,000.

Kan., Coffeyville—Cooperative Refinery Assn., P. O. Box 570, has awarded the contract for the construction of a dewaxing plant to Process Engineers, Inc., 5635 Daniels St., Dallas, Tex. Estimated cost $2,200,000.

Kan., Kansas City—Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., has awarded the contract for an addition to its soap manufacturing plant here to S. Patti Construction Co., 1340 Admiral Blvd., Kansas City, Mo. Estimated cost will exceed $1,000,000.

La., Harvey—Texas Co., c/o H. K. Ferguson Co., contractors, 1054 M A & M Bldg., Houston, Tex., will construct a warehouse and office here. Estimated cost will exceed $150,000.

Miss., Belzoni—Belzoni Oil Works, Inc., c/o A. T. Oakes, Constr. Supt., will construct an oil plant with own forces. Estimated cost $250,000.

Miss., Canton—Mississippi Federated Cooperatives Fertilizer Co., Canton, has awarded the contract for an addition to its manufacturing plant to John J. Harte Co., Techwood Dr., N. W., Atlanta, Ga. Estimated cost $225,000.

Mo., St. Louis—Anheuser-Busch, Inc., 721 Pestalozzi St., has awarded the contract for two additions to its starch plant, 2 story, 31x128 ft. and 6 story, 45x57 ft., to Fruin-Colnon Contracting Co., 1706 Olive St. Estimated cost $100,000.

Pa., Philadelphia—E. I. du Pont de Nemours & Co., Inc., Nemours Bldg., Wilmington, Del., has awarded the contract for the construction of a research laboratory to Wark & Co., 1700 Sansom St. Estimated cost $1,500,000.

Pa., Philadelphia—Franklin Process Co., yarn dyers, 364 Eddy St., Providence, R. I., has awarded the contract for alterations to its plant here to Robert E. Lamb & Son, Inc., 3429 West Indiana Ave. Estimated cost $80,000.

Tex., Agua Dulce—Panhandle Producing & Refining Co., City Natl. Bank Bldg., Houston, will construct a gas compressor plant here. Work will be done by owners. Estimated cost $650,000.

Tex., Alice—Humble Oil & Refining Co., Humble Bldg., Houston, will construct a gas injection plant in this vicinity. Work will be done by purchase and hire. Estimated cost $125,000.

Tex., Austin—Jefferson Chemical Co., Dallas Hy., has awarded the contract for a laboratory building to J. M. Odom, 914 Congress St., Austin. Estimated cost $265,000.

Tex., Dallas—Eastman Kodak Co., Rochester, N. Y., has awarded the contract for a 3 story plant here to Henry C. Beck, 1205 Irwin Kessler Bldg., Dallas. Estimated cost $1,259,383.

Tex., Falfurrias — LaGloria Corp., Driscoll Bldg., Corpus Christi, will construct a gasoline recovery plant. Work will be done by owners. Estimated cost $650,000.

Tex., Galveston—Pittsburgh Plate Glass Co., 2311 Mechanic St., will remodel and construct an addition to its glass plant. Work will be done with own forces. Estimated cost $75,000.

Tex., McAllen—Mayfaire Minerals, Inc., and Coastal Refineries, Inc., c/o V. E. Cook, has awarded the contract for a cycling plant to Gasoline Plants Construction Co., Niels Esperson Bldg., Houston. Estimated cost $1,000,000.

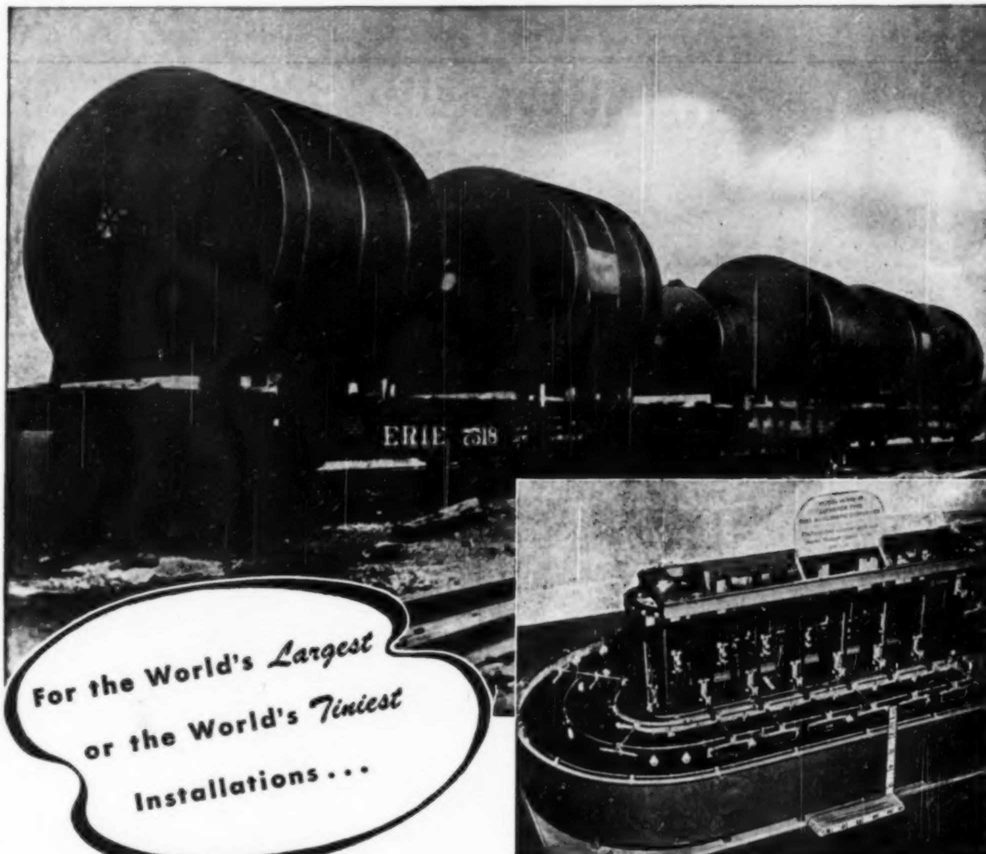
Wis., Green Bay—Green Bay Fertilizer Co., Inc., Green Bay, has awarded the contract for a 1 story, 51x101 ft. warehouse and 20x101 ft. loading platform to J. C. Basten, 1329 Main St.

Ont., London—Gair Co. of Canada, Ltd., 745 York St., has awarded the contract for 2 story, 80x375 ft. and 1 story, 45x80 ft. additions to its plant to Canada Construction Co., Ltd., 131 deForest Rd., Toronto. Estimated cost $400,000.

Ont., Mathieson—Canadian Johns Manville Co., Ltd., Asbestos, Que., plans to construct a 50 ton mill here to handle 500 tons of ore per day. Work will be done by owners. Estimated cost $100,000.

Que., Montreal—International Paint Canada, Ltd., 6700 Park Ave., has awarded the contract for a 1 story, 60x180 ft. varnish plant to Ross & Anglin, Ltd., 4400 St. Catherine St., W. Estimated cost $330,000.

Ont., Toronto—Universal Paper Products Co. of Canada, 355 Logan Ave., has awarded the contract for a 2 story factory on Danforth Rd., to Dritzer & Conforze Co., Ltd., 19 South Dufferin St. Estimated cost $90,000.



Engineers choose Manhattan Rubber for Tank Linings

Pictured above are six of a trainload of fifteen tanks, rubber lined by Raybestos-Manhattan, Inc., for the world's largest water conditioning plant. Large quantities of pipe and fittings also were rubber lined by Manhattan for this fully automatic demineralizing and silica removal system.

This equipment will handle water from Lake Huron at atmospheric temperature and purified at a rate of 2,000 gallons per minute. It supplies 1,400 lbs. per square inch to boilers for generating electric power. Belco Industrial Equipment Division of Bogue Electric Manufacturing Co. of Paterson, N. J. engineered and supplied the installation for a big midwest chemical plant.

Inset shows the world's tiniest installation of its kind rubber lined by Manhattan. It is a 40" long scale model, Full Automatic Elevator Type Plating Machine. Hanson, Van Winkle, Munning Company exhibit it at trade shows, to gold plate souvenir charms. It is a dramatic action model of the World's Largest Plating Tank which required seven flat cars to ship when Manhattan Rubber lined it in 1945.

If you have a rubber lining project, it pays to call on Raybestos-Manhattan engineers, whose proved capacity and skill to rubber line the largest and the tiniest of jobs insures safe handling of your equipment.

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Fig. 1847—200-pound Stainless Steel Swing Check Valve with screwed-in cap and regrindable, renewable disc.

Fig. 2453-G—Large 150-pound Stainless Steel Gate Valve with bolted flanged yoke-bonnet, outside screw rising stem and tapered solid wedge. Made in sizes 5" to 30", inclusive.

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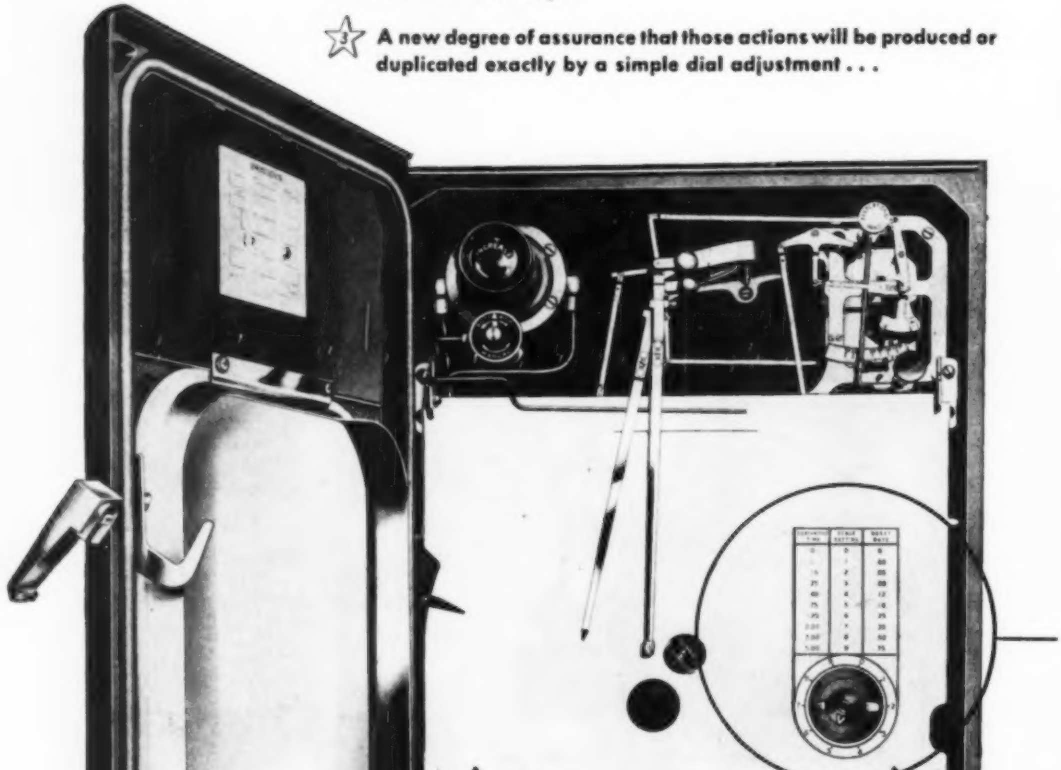
WITH BRISTOL'S NEW CONTROLLERS

1. **A new standard in automatic control . . .**
2. **A new opportunity to produce any desired control action with infallible accuracy . . .**
3. **A new degree of assurance that those actions will be produced or duplicated exactly by a simple dial adjustment . . .**



BRISTOL'S ***Series 500 Air-Operated Controllers***
for temperature, pressure, flow, liquid level

These Features are NEW and EXCLUSIVE

WITH BRISTOL'S SERIES 500 CONTROLLERS

1 RESET, DERIVATIVE AND PROPORTIONAL TIME VALUES REPRODUCIBLE

Adjustments are accurately calibrated and exactly reproducible. Similar settings in any Series 500 Controller will produce *exactly the same* values.

This means that you can standardize controller adjustments for any given process throughout a plant or throughout a national organization. It also means you can replace controllers on a process with full assurance that such replacements will exactly duplicate the performance of the original.

No more cut-and-try to arrive at the original setting... saves hours by reducing shutdown time.

2 SIMPLEST CONTROL SYSTEM TO SERVICE

Only one service adjustment is needed. The control units and parts making up the control system are so accurately designed and tolerances are so closely controlled that the system can be completely disassembled and reassembled, even with replacement parts, with only one simple adjustment needed to put the system in exact calibration.

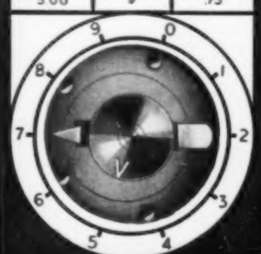
Almost anybody can service a Bristol Series 500 Controller.

3 ALL RESET CONTROLLERS HAVE RESET ACTION STOPS

Ask about this *new* advancement in automatic control.

CALIBRATED SCALE

DERIVATIVE TIME	SCALE SETTING	RESET RATE
0	0	0
.1	1	.03
.15	2	.05
.25	3	.08
.40	4	.12
.75	5	.18
1.20	6	.25
2.00	7	.35
3.00	8	.50
5.00	9	.75



Reset rate and derivative time adjustments are calibrated in equal percentage (or logarithmic) steps. Changes of one step up or down from any setting will produce a change which is a constant percentage of the previous setting—the most convenient way to calibrate an industrial adjustment.

With these calibrated adjustments, you can positively reproduce, at any time, any previously-established control action . . . by merely duplicating the settings on the scales—in the same or in any like Series 500 Controller.

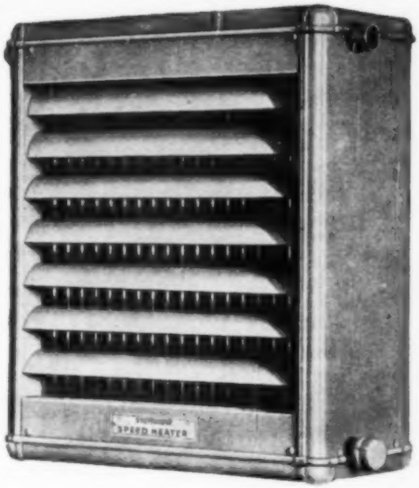
Five types of control: on-and-off, proportional, proportional plus derivative, reset, reset plus derivative.

Investigate your new opportunity for accuracy and uniformity in automatic control. Write us for new bulletin. The Bristol Company, 109 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont., Bristol's Instruments Co., Ltd., Lynch Lane, Weymouth, Dorset, England).

60 YEARS...1889-1949

BRISTOL

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

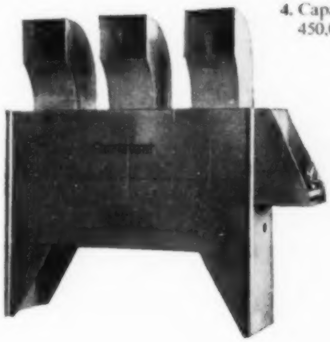


SPEEDHEATER®

1. Fast Heat Delivery—Assured by efficient, quiet-operating fan
2. Low Maintenance Cost—Single-row radiator assures uniform tube expansion, freedom from radiator distortion. Longer life. Tested for 200-lbs. steam pressure
3. Dependable Westinghouse Motor—Backed by nationwide Motor Service Plan
4. Simplified Installation—Inlet and outlet connections on either side
5. Easily formed Handy Hangers—At no extra cost
6. Capacities—From 25,000 to 300,000 Btuh

DOWNBLAST SPEEDHEATER

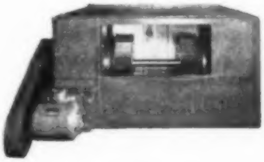
1. Excellent Heat Distribution for High-ceiling Applications
2. Greatly Reduced Ceiling Heat Loss, Lower Fuel Costs
3. Connections on Both Sides Save Piping Costs
4. Capacities From 40,000 to 450,000 Btuh



MULTIVANE HEATER

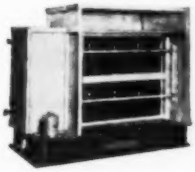
1. Large Volumes of Heated Air, Evenly Distributed
2. Rugged, Simple Construction; Working Parts Easily Accessible
3. Installed on Floor, Wall or Ceiling
4. Capacities, 44,100 to 1,177,000 Btuh

Westinghouse
Sturtevant Division



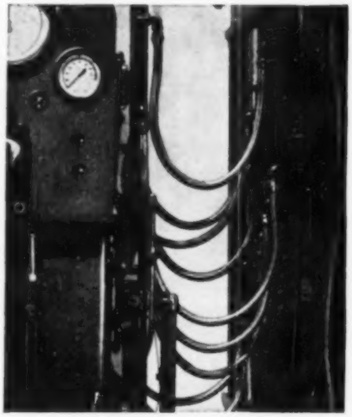
AIR HANDLING UNITS

PRECIPITRON®
(ELECTRONIC AIR CLEANER)



SURFACE DEHUMIDIFIERS

make it flexible and pressureproof



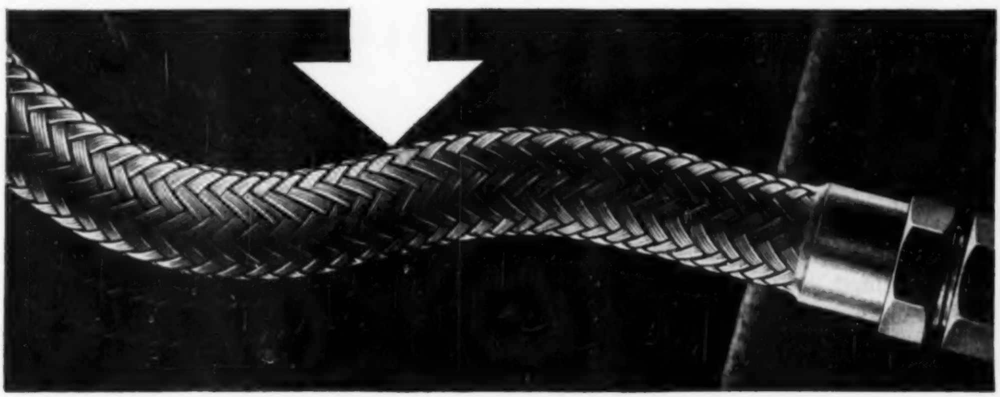
Steam to the moving platens of this hot plate press, made by Williams, White & Co., of Moline, Ill., is carried through these ½" I. D. Bronze American Seamless Flexible Metal Connectors.

Are you plagued with piping that must move, that vibrates, or has connections that are out of alignment?

Whether it carries fluids, gases, semisolids or steam, there's a type of American *Seamless* Flexible Metal Tubing or Flexible Metal Hose to do the job. Neither heat, pressure nor corrosion presents a problem.

American Seamless Flexible Tubing is made of seamless corrugated tubes of bronze and other workable metals, in standard sizes from ⅛" up. They are reinforced with one, two or three pressure-resistant coverings of wire braid. American Flexible Metal Hose is made of spirally wound continuous strips of brass, bronze, aluminum, steel and other metals in ⅛" to 12" I. D. sizes.

For illustrated literature, or the help of our Technical Department, just address The American Brass Company, American Metal Hose Branch, Waterbury 88, Connecticut. In Canada, The Canadian Fairbanks-Morse Co., Ltd.



wherever connectors must move

ANACONDA

American

FLEXIBLE METAL HOSE AND TUBING

Zinc Chloride

FOR USE IN—Preserving wood; Finishing paper and textiles; Flameproofing and dyeing textiles; Galvanizing; Manufacturing vulcanized fibre, batteries and glue.

Zinc Sulphate

FOR USE IN—Fertilizers and orchard sprays; dyeing and printing textiles; Electro plating; Electro galvanizing; making rayon, paint, varnish, glue.

At Wheatland, Pa., Maneely Chemical Company has one of the most efficient, modernly equipped chemical plants in the country.

Glass lined vats and equipment and a new process combine to give a new high in uniformity, purity and quality.

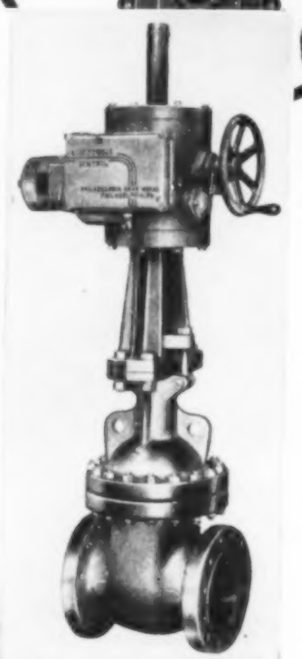
Manco

Maneely CHEMICAL COMPANY

Dept. C • 1300 Bankers Securities Bldg. • Philadelphia 7, Pa.
Plant, Wheatland, Pa.

POSITIVE, SAFE AND AUTOMATIC

Remote Control
OF VALVES
BY
Limitorque



By the push on a button, the opening and closing operations of valves of all types are speeded up, while labor costs are simultaneously reduced. Doors, damper controls, sprinkler systems, feeder disconnect switches, marine ventilating covers, watertight bulkhead doors, as well as Gate, Globe, Butterfly, Plug valves and sluice gates can be easily and automatically operated.

LimiTorque Control gives absolute assurance against improper seating, by means of a positive safety overload mechanical torque cut-out. . . . If obstruction is met in closing valve, torque switch becomes operative and disconnects the motive power—thus preventing broken gates or discs and damaged stems.

Various types of **LimiTorque** Controls are available for different valve requirements on all types and makes of valves—also, they can be adapted to existing equipment. And, where it is not practical to fit the controls directly to the valve yokes, floor stands can be provided.

NOTE: Send for 96 page "Limitorque" Catalog—and please use your Business Letterhead when requesting same

Philadelphia Gear Works, INC.

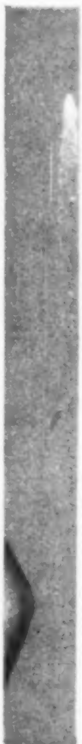
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls


BAKER
PLATINUM
LABORATORY
WARE
Baker platinum laboratory ware is made under the direct supervision of scientific men who use it daily in our own laboratories.
No better controlled manufacturing conditions could be devised for the production of apparatus with the metallurgical and mechanical precision required for scientific use.
The natural result is that Baker laboratory ware is continuously under test and as improvements have suggested themselves, they have been made. Instances are the introduction of platinum-rhodium for this ware, our reinforced rim crucibles and dishes, the Baker Low Form crucible and the reinforcement of the junction of stem and cylinder in stationary type electrodes.
Our *Data Concerning Platinum* contains a catalogue of Baker laboratory ware as well as useful tables and other valuable information. Send for a copy.
BAKER & CO., INC.
113 Astor St., Newark 5, N. J.
New York 7 - Chicago 2
San Francisco 2

RESPIRATOR

of Cartridges and Filter!



AO presents the R2000 Respirator with a new type of retainer shell that accommodates 7 types of quickly INTERCHANGEABLE cartridges — THREE FOR PROTECTION AGAINST DUSTS — FOUR FOR GASES AND VAPORS — plus a DISK TYPE. CHEMICALLY TREATED DUST FILTER — eight respirators in one. Thus, for the first time, an overall dust respirator of the chemically treated, replaceable filter type provides secure protection against both specific dusts and specific gas and vapor hazards merely by interchanging the cartridges.

Four new all metal chemical cartridges of NON-SPARKING, seamless aluminum protect against fire hazards, weigh less than previous types and have increased fill for added adsorptive capacity. Deterioration caused by moisture and rough handling is retarded.

APPLICATIONS & ADAPTATIONS

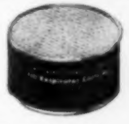
R2000

Compact, five inch chemically treated "throw away" R25 filter has the efficiency of previous filters eight times its size. Protects against both poisonous and disease-producing dusts and against a *combination of all dusts* — toxic, nuisance and pneumoconiosis-producing. Gauze pre-filter adds to filter life by blocking entry of larger particles. Approved by Bureau of Mines, No. 2154.

R2031 — (R31 Cartridge)
For low concentrations of light organic fumes, vapors and gases generated in paint spraying, degreasing, dry cleaning, cementing, etc. Adsorbs benzene, xylene, toluene, gasoline, acetone, turpentine, etc.

R2032 — (R32 Cartridge)
For low concentrations of acid gases, fumes and mists such as sulphuric acid, hydrogen chloride, nitric acid. Protects against fumes from plating and pickling tanks, etc.

R2033 — (R33 Cartridge)
For low concentrations of combined acid and organic gases such as halogenated hydrocarbons and trichlorethylene; carbon tetrachloride, acetic acid. Protects against gases, fumes and vapors in degreasing operations, etc.



R2034 — (R34 Cartridge)
For nuisance concentrations of ammonia only.

American Optical
COMPANY

Southbridge, Massachusetts
Branches in Principal Cities

NOW IT'S HERE... *the New "VAREC" Electronic Gauger!*

COSTS YOU LESS

Initial costs are lower because the new electronic design eliminates Selsyn Motors. Installation costs are less because fewer and smaller wires are used.

GIVES YOU GREATER ACCURACY

Accuracy is only limited by types of float gauge used. Measures liquid level to ± 1/16" with "VAREC" 253 Series Automatic Tank Gauges. Not affected by wide line voltage variations.

PROMOTES SAFETY

No climbing on slippery tanks during wet or icy weather. No danger from toxic vapors. Low voltage, low current transmitter completely isolated from tank vapors.

EASY TO OPERATE AND MAINTAIN

You need only select the tank to obtain an accurate continuous gauge reading. You need only push a button to instantaneously check receiver adjustments. It is not necessary to reset instrument after power failure.

GREATER VERSATILITY

Transmitters may be installed on tanks already equipped with suitable float-type gauges. Small, compact receiver may be located on desk or panel mounted. Readings may be made at more than one remote position by installing additional receivers. High-low level alarms or controls may be added to the receiver without running additional wires to the tanks.

Fig. No. 801 "VAREC" Fingertip Electronic Gauge Receiver

REMOTE LIQUID LEVEL GAUGING AT ITS BEST!

Now you can gauge your tanks accurately to within ± 1/16" of tank level on a centrally located panel. The new "VAREC" Electronic Gauges enable you to duplicate tank gauge readings at any location... gives you greater accuracy when installed with "VAREC" Automatic Tank Gauges. Eliminates traveling throughout the tank farm or gauging tanks outside during bad weather. Eliminates the dangers of toxic vapors. Eliminates the errors from the human element in gauging.

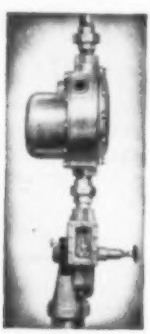
MULTIPLE OR SINGLE TANK RECEIVERS

Multiple Tank Receivers, for individual gauging up to 10 tanks or up to 24 tanks; On-Gauge Receivers for individual tanks or simultaneous gauging. The front panel of each receiver has two dials. Feet indications from 0 to 54 feet are read on the left-hand dial and inch indications from 0 to 12 inches by 1/8" increments are read on the right-hand dial. Proper reading of the foot scale is designated by two colored pilot lights at the upper corners of the dial. The receivers are designed for use on 110-115 volt, 50-60 cycle, a-c power.

EXPLOSION-PROOF TRANSMITTERS

Transmitters are available in four designs to meet tank working pressure requirements. All are designed to be explosion-proof, suitable for use in Class 1, Group D, hazardous locations.

Fig. No. 850 Electronic Gauger Transmitter installed above lookbox of "VAREC" Fig. No. 253 Automatic Tank Gauge.



"Varec" PROVED — APPROVED

THE VAPOR RECOVERY SYSTEMS COMPANY
NEW YORK PITTSBURGH CHICAGO TULSA HOUSTON
COMPTON, CALIFORNIA, U. S. A.

DEPT: CE

NAME ______________________ TITLE ______________

STREET and No. ______________________

CITY and STATE ______________________

Send for Your Copy of "Remote Gauging at Its Best" Today!

SEE THE "VAREC" ELECTRONIC GAUGER AT THE I. S. A. INSTRUMENT EXHIBIT IN ST. LOUIS SEPTEMBER 12-16

Keeping the Navy "*Ship Shape*" with the Dempster-Dumpster . .

Shipyards, stations, and the men in Uncle Sam's Navy set a standard of cleanliness that is unsurpassed. Helping to maintain this high standard of Navy cleanliness is the Dempster-Dumpster System of materials handling . . . a system of quick pick-up of preloaded containers for hauling, dumping or moving materials.

Exactly 10 years ago the Navy purchased its first Dempster-Dumpster equipment . . . one truck hoisting unit with several containers. Now there are dozens of hoisting units and thousands of Dempster-Dumpster containers of many types at work keeping Navy yards and stations "ship shape." The sturdy steel foolproof and fireproof containers are placed at various places, such as barracks, mess halls, the docks and ship yards, wherever materials (solids or liquids) need be deposited immediately as they accumulate. A Dempster-Dumpster truck hoisting unit quickly picks-up each container when it is filled and hauls it to the disposal area. Contents are automatically dumped and container returned.

If you have a materials handling problem demanding more cleanliness, more economy, and more efficiency, it will pay you to investigate the Dempster-Dumpster System—popularly used, not only by the armed forces, but by municipalities, leading industrial plants, and by large and small institutions of all kinds.

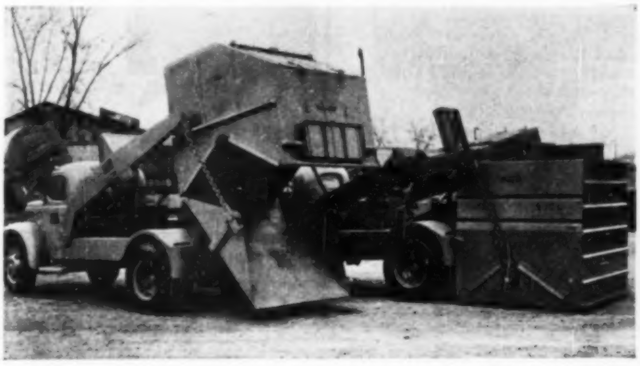


Photo above shows eleven hoisting units recently delivered to the U. S. Navy. Various types of containers are shown in carrying positions. Photo at left shows a hoisting unit preparing to lift a 10 cu. yd. Flat Top container, while another hoisting unit is dumping a 9 cu. yd. Trash and Rubbish Kolector type container. All controls of unit are conveniently located at the driver's seat. One driver and one truck handles any number of containers regardless of types.

DEMPSTER BROTHERS INC.

289 DEMPSTER BLDG.
KNOXVILLE 17, TENN.

WHERE TO BUY

Featuring additional Equipment, Materials, Supplies & Services for the Process Industry

A Good Habit

This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in this field. Make a habit of checking this page each issue.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:
(Not available for equipment advertising)
$1.20 a line, minimum 4 lines.
To figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

INFORMATION
BOX NUMBERS care publication New York, Chicago or San Francisco offices count as one line additional in undisplayed ads.
DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:
The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
C. E.

NEW ADVERTISEMENTS received by 10 A. M. August 29th will appear in the September issue subject to limitations of space available

ENGINEERS
CHEMICAL and METALLURGICAL
Salaries $2700 - $15,000
"For the Better position with the better firm!"
Call, write, or wire:-
Gladys Hunting (Consultant)
DRAKE PERSONNEL, INC.
7 West Madison St. Chicago 2, Ill.

We aren't looking for a genius! But the man we do want and need is not just an ordinary boss.

He is probably in his late thirties, and has done his bachelor's and master's work in chemistry or chemical engineering. He may have—or be approaching—his doctorate.

We believe he should have had some few years experience in industrial research with a relatively large research organization, during which time he began to prove his ability as an administrator.

He should be thoroughly research minded, and yet have the ability to cooperate with all parts of an industrial organization.

He would want to become the Director of Research for a nationally known firm, bringing with him the ability and the desire to guide and direct the existing nucleus of a research group to continuing recognized leadership in the industry.

We believe that the salary will be attractive, the future secure, though challenging.

If you are this man—or his friend—your inquiry in confidence should be sent to:

P-9379, Chemical Engineering
330 W. 42nd Street, New York 18, N. Y.

WANTED
MANUFACTURERS REPRESENTATIVE
for Chicago area. Unusual opportunity for an aggressive engineer with sales ability. Company manufactures and installs corrosion resisting linings, coatings and masonry structures.
RW-9574, Chemical Engineering
330 West 42nd St., New York 18, N. Y.

PHYSICAL CHEMIST
or PHYSICIST
Experienced In Solid State Physics
PH.D. or Equivalent. Send Resume.
GENERAL EMPLOYMENT SERVICE,
440 THE ARCADE, CLEVE. 14, OHIO

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

SALES ENGINEER wanted, who is thoroughly familiar with processing equipment for oil refineries and chemical plants in carbon and alloy steels and who is well known in the industries. Prefer younger man, age 30-35, willing to make a success. Please submit your resumes under P-9433, Chemical Engineering.

POSITION VACANT

WANTED: INDUSTRIAL Engineer for large rayon manufacturing and processing plant. College graduate in Mechanical or Industrial Engineering preferred. Must have adequate training in time and motion study, job analysis, work simplification, and several years' experience in the textile industry. Successful applicant will be required to organize industrial engineering department, teach work simplification to supervisory staff, and develop comprehensive work reduction program. Must have good personality and ability to work cooperatively with all levels of supervision and to assist in labor negotiations involving work leads. Only high-grade individuals need apply. Salary up to $10,000, depending upon proven ability to achieve desired results. Replies confidential. P-9208, Chemical Engineering.

EMPLOYMENT SERVICES

SALARIED POSITIONS $2,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (39 years recognized standing and reputation). The procedure of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 260 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

CHEMICAL DIVISION Head: Ph.D., 38, at present head of chemical division of one of the largest inorganic chemical manufacturing companies. Fifteen years industrial experience in production, research, and development. PW-9212, Chemical Engineering.

CHEMICAL ENGINEER—Purdue University—age 30, diversified experience production, research, sales. Desires opportunity; salary secondary. PW-9353, Chemical Engineering.

CHEMICAL ENGINEER-B.Ch.E. 1941, 30, family. Seven years varied production, one year development. Seven plants, two companies. Will consider any field. References from employers. PW-9369, Chemical Engineering.

CHEMICAL ENGINEER: B. Ch.E., '41—has been out of field for two years, desires to return. Previous record good. Experience primarily in petroleum refining. Plant technical service would be best placement. Realize necessity for competing with recent graduates in all respects. PW-9569, Chemical Engineering.

CHEMICAL ENGINEER—Three years exp. in rubber research & development. Desires position with a future in progressive company. Single, employed. PW-9540, Chemical Engineering.

CHEMICAL ENGINEER Recent graduate B.E. degree single, 27, desires position offering experience in the organic field. Location and salary secondary. PW-9551, Chemical Engineering.

LICENSED CHEMICAL Engineer B.S. Ch. E. Purdue. Graduate credits. Desire opportunity in production supervision or process development. Eight years responsible supervision commercial and military explosives. Three years process design and chemical plant engineering. 33, married. PW-9560, Chemical Engineering.

CHEMICAL ENGINEER, B.S., Graduate work. 2½ years in propellant research, formulation, and compounding of propellant powders. Previously with large cement manufacturing company. Desire process development or production. Location immaterial. Married. PW-9559, Chemical Engineering.

RECENT CHEMICAL Engineering graduate from Case Institute of Technology desires employment in Ontario or Quebec. PW-9566, Chemical Engineering.

POSITIONS WANTED

CHEMICAL ENGINEER: B.S. and M.S. in Ch. E. Elected Sigma Xi. 5 years exp. in engineering research, process improvement, production supervision. Desire position which utilized past background in combination with opportunity where personal contacts can be experienced, preferably technical service. Age 27, veteran. PW-9538, Chemical Engineering.

DRAFTSMAN 3 yrs. exp. oil refinery const. Economical layouts in plan and section of process piping, and isometric dwgs for the fabrication of piping. Knowledge of structural st'l. Also 3 yrs. exp. in the layout and detailing of mech. equipment. Some college, resident N.Y.C. consider traveling. PW-9580, Chemical Engineering.

SELLING OPPORTUNITY WANTED

MANUFACTURERS AGENT in San Francisco desires equipment accounts for chemical, petroleum, power, water and sewage plants. Graduate chemical engineer. RA-9570, Chemical Engineering.

To Employers Who Advertise for Men:

The letters you receive in answer to your advertisements are submitted with the hope of securing the position offered.

Frequently, when there are many applicants, the only letters acknowledged are those of promising candidates. Others receive no indication that their letters have even been received, much less given consideration. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every Advertisement Printed in the Searchlight Section Is Duly Authorized. Now won't you help keep our readers interested in this advertising by acknowledging every application received, even if you merely return the letters of unsuccessful applicants marked, "Position filled, thank you." If you don't care to reveal your identity, mail them in plain envelopes.

We suggest this in a spirit of helpful co-operation between employers and the men replying to Positions Vacant advertisements.

"Put Yourself in the Place of the Other Fellow"

Classified Advertising Division

McGRAW-HILL PUBLISHING COMPANY, INC.

Fit for Duty!

THE GELB GIRL—AUGUST 1949

AND THAT TOO DESCRIBES

GELB MACHINERY

THE MACHINE YOU WANT—THE VALUE YOU WANT—AT THE PRICE YOU LIKE

1—J. H. Day double arm, jacketed mixer, sigma blades, 500 gals.
1—Baker-Perkins, double arm jacketed mixer, 2000 gals.
3—J. H. Day double arm jacketed mixers, 50 gals, sigma blades
1—Baker-Perkins double arm jacketed mixer, 200 gals, sigma blades
5—Baker-Perkins double arm, mixers, 200 gals, sigma blades
1—J. H. Day Mogul type mixer, 5 gals.
5—Simpson #0 Intensive mixers
1—Baker-Perkins jacketed lab mixer, size 6, Stainless Steel

1—Shriver 42" x 42" Filter Press, 46 chambers, with hydraulic closing.
1—Shriver 36" x 36" Filter Press, closed delivery.
1—Shriver 42" Skeleton.
1—Sperry Plate & Frame Aluminum Filter Press, 18" x 18".
1—Shriver bronze plate & frame Filter Press, 18" x 18".
1—Sparkler Stainless Steel filter model 18 D 8.
1—Sweetland #5 Stainless Steel filter.
1—Vallez #3 Filter.
1—EEMCO 2 roll lab mill, 6" x 12", with Reeves drive and motor
1—Royle #1 Prefected Extruder, with heating unit.
1—Allis-Chalmers Ball Mill, 5'8" x 18', Silex lined.
3—Hardinge Conical Ball Mills, 8' x 30", 5' x 24", 5' x 22" Steel Jacketed Kettle, 300 gals, with mixer, ASME.
1—Plate Fabricators, jacketed kettle, 900 gals, 125 P. S. I. ASME.
1—Steel Jacketed Kettle, 7'3' x 7'.
1—Cast Iron Jacketed Kettle, 300 gals.
1—Buffalo Cast Iron Jacketed Kettle, 600 gals, with mixer.
2—Glasscote Jacketed Glass Lined Kettles, 350 gals.
1—Glasscote Jacketed Glass Lined Kettle, 50 gals.
1—Pfaudler Aluminum Jacketed Reactor, 1300 gals.
1—Pfaudler Aluminum Jacketed Reactor, 250 gals.
1—Blaw-Knox Jacketed Autoclave, 3' x 4'2", with agitator.
1—Dopp 150 gal. Jacketed Kettle, with double motion mixer.
1—Stainless Steel Tank, 10' x 20'.
2—Rubber Lined Storage Tanks, 7,800 gals.
1—Rubber Lined Storage Tank, 30,000 gals.
1—Steel Storage Tank, 21,000 gals.
2—Nickle Jacketed Stills, 4' x 5'.
1—Stainless Steel Direct Fire Still, 6' x 8', with coils & agitator.
5—Monel Storage Tanks, 1,800 gals.
1—Steel Storage Tank, 10,000 gals, 1" plate.
2—Steel Pressure Tanks, 4' x 11', 200 P. S. I.
1—Stainless Steel Tank, 10' x 20'.
1—Nickle Lined Jacketed Kettle, 4,000 gals.
2—Black & Clawson Double Drum Dryers, 28" x 5'.
3—Louisville Rotary Steam Tube Dryers, 6' x 50'.
1—Louisville Rotary Steam Tube Dryer, 54" x 30'.
2—Buffalo Double Door Vacuum Shelf Dryers, 12 & 14 shelves.
1—Buffalo Single Door Vacuum Shelf Dryer, 17 shelves.
1—Bartlet & Snow direct fired kiln, 8½' x 50'.
1—Ruggles Cole direct fire kiln, 7' x 60'.
3—Buffalo Flakers, 5' x 12'.
1—Buffalo double drum dryer, 36" x 72", chrome plated drums.
1—Fuller Air Compressor Model 0-300.
1—Micro-Pulverizer #2th.
1—Micro-Pulverizer #1SH.
1—Fitzpatrick Style D Comminuting Machine.

1—Bird Suspended type Centrifuge, 40" Stainless Steel perforated basket with motor
1—Tolhurst Suspended type Centrifuge, 40" rubber perforated basket, with motor
1—Tolhurst center slung Centrifuge, 30" rubber basket, with motor
1—Tolhurst solid curb centrifuge, 20" rubber basket, with motor
1—Podbielniak Stainless Steel centrifugal extractor, model 4080
10—Sharples Super-Pressurite Centrifuges, with 3 H.P. Expl. proof motors
1—Sharples Super Pressurite Centrifuge, Stainless Steel Bowl, Model 18 V

2—Ball & Jewel #0 Rotary Cutters.
1—Ball & Jewel #1 Rotary Cutter.
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1—Sperry C.I., 24", 15 Rec. Pl., open
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1—Sperry P&F C.I., 12", 10 ch., cl. dely
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Lancaster Muller Type Mixer Model EBG4
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De-airing Brick Extruder and Cutter
Kilns, Superheaters, Blowers, Conveyors

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4—Stainless Steel Kettles good-as-new 150 gal.-200 gal.
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4—Stainless Steel Pressure Vessels; 3' x 5', 4' x 5', and 5' x 8' one Jacketed 3' x 5'
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1—Penn. single roll 18" x 24".
1—Pebble 4' x 5' Patterson Type D.
1—Raymond 3-roll low side, complete.
1—#8 Williams-Hammer.
1—Jeffrey A2, 36 x 24, Swing Hammer.
1—Abbe, 4-cage, 22" x 12".
1—Bartlett & Snow, 2-roll spiked, 14 x 16. (UNUSED).
1—Micro #2 Hammermill.

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1—Stokes, Rotary Vacuum 3' x 15', comp. including structural steel.
1—Hardinge, single drum, 10'6" x 14'5".
1—Phila. Truck 2 compt. 8 trucks.
1—Double Drum Atmospheric 28" x 60".
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1—Traylor, Rotary, 4' x 30'.
1—Link Belt, 3'10" x 16', Roto Louvre.

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1—Jeffrey 68' MI Buckets 10" x 6".

EVAPORATOR—Swenson, triple effect, 800 sq. ft. per effect.

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1—5'4" x 6' Oliver cont., wood drum.
1—8' x 10' Oliver continuous wood drum.
2—8' x 10' Oliver, precoat bronze drum.
1—6x6 Eimco cont., s.s. type 316 drum.
1—8 x 8 Eimco continuous wood drum.
1—Sweetland #12, 72 leaves, 2" spacing.
1—Sweetland #12, steel nickel chrome alloy.
1—Shriver 36", 50 Celoron Plates & Frames.

MIXERS—1—#3 Super Ajax, 173 gals.
1—Champion, Type E, Size 2, 110 gals.
1—1½ SA Readco, 88 gals.
2—Blystone, 67 cu. ft.

PUMPS—Centrifugal, from 20 to 2500 gals. Vacuum, Stokes Mod. 212C, 100 CFM (4).

REACTORS—1—Pfaudler, 300 gal. enameled, jacketed, ASME. (NEW).
1—Pfaudler, 500 gal., enameled, jacketed, ASME, (NEW).

SPEED REDUCERS—Ratio 4-1 to 263-1, 3 to 10 HP.
Vari-Speed, ratio 2-1 to 6-1, 3 to 7½ HP.

TANKS—1—2300 gal. hor. 5' x 15'2" x ¼".
1—2200 gal. vert. s.s. 7' x 7' x ¼".
1—3000 gal. hor. 6'6" x 10' x 5/16".
1—3300 gal. hor. 6' x 14'. (NEW).
2—4000 gal. hor. 6' x 20'3" x 5/16". (NEW).
1—5000 gal. hor. 6' x 25'8" x ½". (NEW).
2—9600 gal. vert. 11' x 13'9". (NEW).
2—41000 gal. vert. 12'6"x45'x¼"x5/16".

TANKS-RUBBER LINED—
1—25,000 gal. vert. 12'6" x 25' x ⅝".
1—32,000 gal. hor. 12' x 36' x 7/16".

Heat and Power Co., inc.

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7—Baker Perkins heavy duty jack. Mixers, 200, 100, 50 & 9 gals.
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3—Hardinge Conical Ball Mills 4½'x24", 3'x24" & 3'x8".
1—Devine Vac. Shelf Dryer 7 shelves 40"x42".
2—Devine #3 Vac. 4 shelf Dryers, elec. heated.
1—Buffalo Vac. Drum Dryer, 24"x20".
1—Badger 42" dia. Monel Bubble Cap Column.
4—Allbright-Nell 4'x9' Atmos. Drum Dryers & Flakers. Also other sizes.
6—Pony or Past Mixers, 8, 15 & 40 gals.
3—Lehman & Ross 3 roll Mills, 3"x9", 9"x32", 12"x30" & 16"x40".
1—Marco Stainless Steel Homogenizer.
Abbe & Ball & Jewell Rotary Cutters 5 to 40 HP.
3—Houchin 18"x30" 4 roll Granite Stone Mills.
2—Farrel 18"x45" & 16"x48" 2 roll motor driven mixing mills.
3—Rubber Tubers & Extruders, 2½" to 6", 6-Banbury Mixers. Midget to No. 3 size.
5—Tyler 38 Jr. Hummer Screens 24"x60" & 20"x60" split screen. Also other sizes. Gt. Western M.D. Sifters.
6—Rotex Sifters 20" x 40" to 40" x 84".
6—Devine Jack. Steel Kettles 250 to 1000 gals.
1—250 gal lead lined Kettle.
5—Shriver 18"x24" wood & lead plate & frame Filter Presses.
12—Sperry & Shriver 12", 18", 24", 30", 32" & 42" iron Filter Presses.
30—Frames, 35 Plates for Sperry 30" Filter.
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1—Sharples #6 Centrifuge 2 HP.
1—Huber type 25 ton Para Block Press.
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1—Faust 150 gal. Jack. Steel Spiral Mixer.
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Sturtevant 36" Rock Emery Mill & Robinson #10 Saw Tooth Crushers.
3—#0000 & #0 Raymond Mills. Also Low & High Side Mills.
2—DeLaval Multiple Clarifiers, #300 & 301.
6—Simpson Intensive Mixers #0 to 3½.
1—Sprout-Waldron 16" D. D. Attrition Mill, two 7½ HP. motors.
2—Worthington 12"x12"x12" Vacuum Pumps.
4—Stokes vertical high Vac. Pumps.
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10—10'6" dia. x 40'6" long steel storage tanks, 26,000 gallons capacity, ⅜" shell, 7/16" heads, welded construction, Franklinton, Louisiana.

6—24' dia. x 20' high, steel storage tanks, 68,000 gallons capacity, ½" 1st ring, 7/16" 2nd ring, ⅜" 3rd ring, ⅜" cone roof, ½" bottom, riveted construction, Point Pleasant, West Virginia.

ROGERS AND WRIGHT, INC.
710 PEOPLES BUILDING
CHARLESTON, WEST VIRGINIA
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1—Cherry Burrell stainless steel centrifugal pump with explosion proof motor rated 15 GPM at 30 lb.

1—12 in., 15 plate Alsop stainless steel sealed disc filter.

1—24 in. Fletcher stainless steel suspended centrifuge with plow and screens.

1—72 sq. ft. Buffalo vacuum tray dryer with stainless steel trays.

1—G-1-D Stokes and Smith dry powder filling machine, stainless steel hopper.

1—Type D Roto-Clone complete with hopper and explosion proof, 1 HP motor.

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Also interested in 3000 to 10,000 gal. stainless or monel tanks.

Complete details must be submitted in first letter containing price, type metal, size etc.

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This unit has neither submerged bearing nor stuffing box. The outlet is at the bottom to make it completely self-draining.

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CHEMICAL PLANT EQUIPMENT

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AN INDUSTRY THAT SERVES INDUSTRIES

ADVERTISERS IN THIS ISSUE

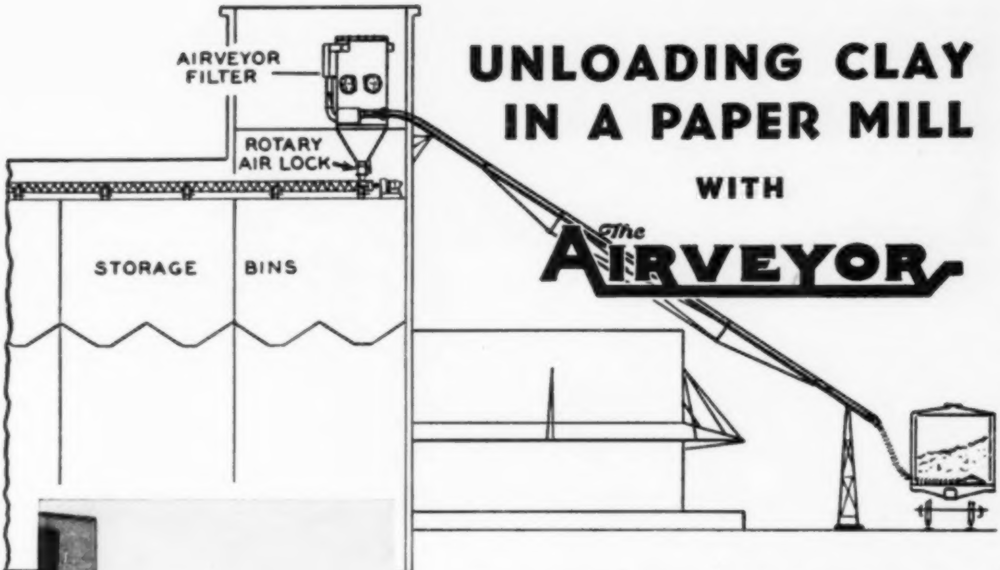
SEARCHLIGHT SECTION
(Classified Advertising)

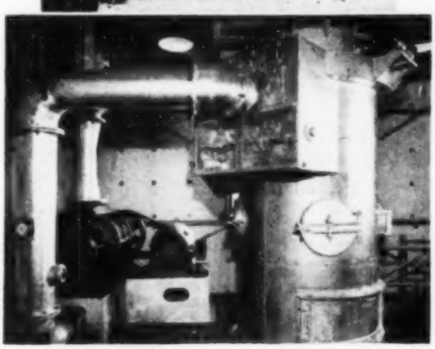
ADVERTISERS INDEX

UNLOADING CLAY IN A PAPER MILL

WITH

The AIRVEYOR





This paper manufacturer, using the Airveyor, saves the difference in price by purchasing coating clays in bulk instead of bags; also in cost of unloading and storing bagged material. Other pertinent advantages are—clean and dustless operation, rapid unloading, minimum of labor, and convenience in storing and reclaiming.

Unloading is accomplished with a flexible hose connection to the permanent conveying duct, and a portable car nozzle, when the clay is received in box cars. Material can also be unloaded from hopper-bottom cars, by using a portable twin nozzle, mounted on a skid base. This device is placed underneath the car, across and resting on the track, and attachment is made to the car hopper, through a flexible canvas connection. There is no dust or loss of material, since the slide gates are not opened until attachment is made and the Airveyor placed in operation.

The process of unloading is as follows: Clay is picked up from the car and conveyed through the permanent conveying duct up to the Airveyor filter; discharged from the filter through a Fuller Rotary Air-lock, for delivery to a screw conveyor distributing to five storage bins. Unloading rate 7½ tons an hour.

A second Airveyor, for handling starch, is also installed in this same plant.

It is possible you may have a material-handling problem. Why not have a Fuller engineer make a survey? Chances are we can help you, the same as we have done for many others.

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CATASAUQUA—PENNSYLVANIA

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A-97

Inside stuff
on a good blower

The blower casing, backplate, inlet connection, and guide vanes, all stationary parts in contact with the medium being handled, are normally made of cast Meehanite. When operating conditions, such as temperature or corrosion, demand, any or all of these parts can be made of steel or nonferrous alloys. With the backplate separate from the base and bearing housing, the use of special alloy material is kept to a minimum.

The open type, one-piece impeller may be made of any material required by the service. Since the impeller is essentially free from end thrust, a relatively simple thrust bearing may be used. Another factor of prime importance is that, with the open type impeller, the packing box seals against blower inlet pressure only, minimizing the possibility of gas leakage to atmosphere.

Elliott centrifugal blowers, single and multi-stage, have a long record of exceptionally satisfactory service in industries requiring the moving of air or gas. Full details in Blower Bulletin P-7, at request.

P-1085

Impellers are balanced statically and dynamically, and are overspeeded well beyond maximum operating speed before assembly with the blower unit.

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Centrifugal Blower Dept., JEANNETTE, PA.
Plants at: Jeannette, Pa. • Ridgway, Pa. Springfield, O. • Newark, N. J.
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